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EFFECTS OF LEADING-EDGE DEVICES ON THE  
LOW-SPEED AERODYNAMIC CHARACTERISTICS OF  
A HIGHLY-SWEPT ARROW-WING

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## SYMBOLS

The longitudinal data are referred to the stability system of axes, and the lateral-directional data are referred to the body system of axes as illustrated in Figure 1. The moment reference center for the tests was located at 59.855 percent of the reference wing mean aerodynamic chord. The reference wing area and reference mean aerodynamic chord are based on the wing planform which results from extending the inboard leading-edge sweep angle  $73.02^\circ$  and the outboard trailing-edge sweep angle  $41.46^\circ$  to the model center line. (See Fig. 2.)

The dimensional quantities herein are given in both the International System of Units (SI) and the U.S. Customary Units. Computer symbols used are given in parentheses.

|               |   |
|---------------|---|
| $A$           | - aspect ratio, $\frac{b^2}{S_{ref}}$   |
| $b$           | - wing span, m (ft)   |
| $C_D$ (CD)    | - drag coefficient, $\frac{Drag}{qS_{ref}}$   |
| $C_{D_i}$     | - induced drag coefficient  |
| $C_{D_{min}}$ | - minimum drag coefficient  |
| $C_{D_{sym}}$ | - drag coefficient of the configuration without twist and camber at zero lift (see pg. 4) |
| $C_L$ (CL)    | - lift coefficient, $\frac{Lift}{qS_{ref}}$   |
| $C_l$ (CRM)   | - rolling-moment, $\frac{Rolling\ moment}{qS_{ref}b}$                                     |
| $C_m$ (CM)    | - pitching-moment coefficient, $\frac{Pitching\ moment}{qS_{ref}\bar{c}}$                 |
| $C_n$ (CYM)   | - yawing-moment coefficient, $\frac{Yawing\ moment}{qS_{ref}b}$                           |



- $C_Y$  (CSF) - side-force coefficient,  $\frac{\text{Side force}}{qS_{\text{ref}}}$   
 $\bar{c}$  - reference mean aerodynamic chord, m (ft)  
 $q$  - free-stream dynamic pressure, Pa (lbf/ft<sup>2</sup>)  
 $S$  - Leading-edge suction parameter  
 $S_{\text{ref}}$  - reference wing area, m<sup>2</sup> (ft<sup>2</sup>)  
 $X, Y, Z$  - body axes system  
 $\alpha$  (ALPHA) - angle of attack, deg  
 $\beta$  (BETA) - angle of sideslip, deg  
 $\delta_f$  - trailing-edge deflection, positive when trailing edge is down, deg  
 $\delta_{\text{L.E.}}$  - leading-edge deflection, positive when leading edge is down, deg

Derivatives:

- $C_{L_\alpha}$  -  $\partial C_L / \partial \alpha$ , per deg  
 $C_{L_\beta}$  -  $\partial C_L / \partial \beta$ , per deg

## Summary

An investigation was conducted in the Texas A & M University 7-by 10-foot Low-Speed Wind Tunnel to provide a direct comparison of the effect of several leading-edge devices on the aerodynamic performance of a highly-swept wing configuration. The tests were conducted over an angle-of-attack range of  $-6^\circ$  to  $16^\circ$ , for a Mach number of 0.21 and a Reynolds number (based on the mean aerodynamic chord) of  $4.1 \times 10^6$ .

Analysis of the data indicates that for the configuration with undeflected leading edges, vortex separation first occurs on the outboard wing panel for angles of attack of approximately  $2^\circ$ , and wing apex vortices become apparent for  $\alpha \geq 4^\circ$ . However, the occurrence of the leading-edge vortex flow may be postponed with leading-edge devices. Of the devices considered, the most promising were a simple leading-edge deflection of  $30^\circ$ , and a leading-edge slat system. The trailing-edge flap effectiveness was found to be essentially the same for the configuration employing either of these more promising leading-edge devices.

Analysis of the lateral-directional data showed that for all of the concepts considered, deflecting the leading edges downward in an attempt to postpone leading-edge vortex flows, has the favorable effect of reducing the effective dihedral.

## Introduction

The National Aeronautics and Space Administration is currently investigating the aerodynamic characteristics of advanced aircraft concepts which are capable of cruising efficiently at supersonic speeds. The conceptual designs are representative of future generation commercial and military vehicles and incorporate wing sweeps on the order of  $70^\circ$  to  $80^\circ$  (e.g., Refs. 1 and 2). Unfortunately such configurations have typically exhibited deficient subsonic aerodynamic characteristics. These deficiencies have been attributed to the formation of leading-edge vortices. Numerous leading-edge devices and concepts have been considered to eliminate or minimize this vortex formation (see, for example, Refs. 3 through 5). The present wing geometry differs slightly from the geometry considered in References 3 through 5. The leading-edge being modified to obtain a constant inboard leading-edge sweep of  $73.05^\circ$ .

The present study was specifically intended to provide a direct comparison of several leading-edge devices. The tests were conducted in the Texas A & M University 7-by-10 ft Wind Tunnel over an angle of attack range from about  $-6^\circ$  to  $16^\circ$  for sideslip angles of  $0^\circ$ ,  $-5^\circ$  and  $-10^\circ$  and at Reynolds numbers (based on the wing mean aerodynamic chord) from  $4.1 \times 10^6$  to  $5.3 \times 10^6$ .

### Model

The principal dimensional characteristics of the model used in the present investigation are listed in Table I and shown in Figures 2 and 3. A sketch of the model and mounting arrangement in the Texas A & M University 7-by 10-foot wind tunnel is shown in Figure 4.

The model incorporated three different leading-edge systems and a trailing-edge flap system as shown in Figure 3. The model did not incorporate either nacelles or an aft fuselage.

### Tests and Correction

The tests were conducted in the Texas A & M University 7-by 10-foot low speed wind tunnel. The model was mounted in a wings vertical attitude so that the wind tunnel turntable could be used to obtain a  $-6^\circ$  to  $16^\circ$  angle of attack range (see Fig. 4). A variable knuckle was used to provide side slip angles of  $0^\circ$ ,  $-5^\circ$  and  $-10^\circ$ . Forces and moments were measured with a standard six-component strain-gage balance mounted internal to the model. Flow visualization was accomplished using 0.048cm (0.019 in.) diameter nylon tufts. Test were conducted at dynamic pressures of 3064.3, 4069.8, and 5123.16 Pa (64, 85, and 107 lbf/ft<sup>2</sup>) these values of dynamic pressure resulted in Reynolds numbers (based on the wing mean aerodynamic chord) of  $4.1 \times 10^6$ ,  $4.8 \times 10^6$ , and  $5.4 \times 10^6$ . The majority of the tests were run at the lower dynamic pressure which resulted in a Mach number of 0.21.

Jet boundary corrections to the angle of attack and drag were applied in accordance with Reference 6. Blockage corrections were applied to the data by the method of Reference 7. Balance chamber pressure and model base pressure were measured and the drag measurements were adjusted to correspond to

conditions of free-stream static pressure acting over the base of the model. An angle-of-attack correction of  $0.8^\circ$  was applied based on comparisons of previous tests of similar configurations (Refs. 3 through 5).

### Presentation of Results

A data supplement containing a run schedule and tabular listing of data is provided in Appendix A. The results and discussion are presented in accordance with the following outline:

#### Longitudinal Aerodynamic Characteristics

Effect of Reynolds number

Effect of leading-edge vortices

Effect of simple leading-edge deflection

Effect of leading-edge slat

Effect of variable chord leading-edge

Comparison of leading-edge devices

Effect of trailing-edge flap deflection

#### Lateral-Directional Aerodynamic Characteristics

Effective dihedral derivative

In addition to the standard longitudinal aerodynamic coefficients  $C_m$ ,  $C_L$ , and  $C_D$  and the lift-drag ratio (L/D); the leading-edge suction parameter (S) is also presented as a figure of merit. The leading-edge suction parameter is fully discussed in References 4 and 5 and is defined as :

$$S = \frac{C_D - [C_{D_{\text{sym}}} + C_L \tan (C_L / C_{L_\alpha})]}{C_L^2 / \pi - C_L \tan (C_L / C_{L_\alpha})}$$

Where  $C_{D_{\text{sym}}}$  is the drag coefficient of the configuration without twist and camber, at zero lift. (See ref. 4 for a discussion of  $C_{D_{\text{sym}}}$ ). The value of

$C_{D_{sym}}$  has been estimated for the present model tests using the relationship

$$C_{D_{sym}} = C_{D_{min}} - \frac{C_L^2}{\pi A} C_{D_{min}}$$

Evaluation of this relationship yields  $C_{D_{sym}} = 0.0107$ . The value of  $C_L \alpha$  has been determined experimentally (from the linear region of  $C_L$  versus  $\alpha$ ) to be 0.039.

### Results and Discussion

The present study was specifically intended to provide a direct comparison for the effect of several leading-edge devices on the aerodynamic performance of highly swept wings. The model did not incorporate either nacelles or an aft fuselage.

#### Longitudinal Aerodynamic Characteristics

Effect of Reynolds Number.— Figure 5 presents the longitudinal aerodynamic characteristics for the configuration with undeflected leading-edges over a range of Reynolds numbers of  $4.1 \times 10^6$  to  $5.3 \times 10^6$ . As can be seen, for the configuration with undeflected leading-edges, increasing the Reynolds number from  $4.1 \times 10^6$  to  $4.8 \times 10^6$  results in only slight changes in  $C_m$ ,  $C_L$ , and  $C_D$ . However, the nature of the changes in  $C_L$  and  $C_D$  are such that significant increases in leading-edge suction and lift-drag ratio occur with increasing Reynolds number. Further increasing the Reynolds number to  $5.3 \times 10^6$  yields no further changes in the aerodynamic characteristics. Reynolds number sensitivity studies were also conducted for a number of deflected leading-edge configurations. These data are not presented, but are contained in the tabulated data of this report. Results of these studies all showed that with deflected leading edges, no Reynolds number effects existed.

Effect of leading-edge vorticies.- References 3 through 5 have shown that this class of highly swept-wing configuration exhibits vortex separation on the outboard wing panel for angles of attack of approximately  $2^\circ$  and that wing apex vorticies become evident for  $\alpha > 4^\circ$ . Flow visualization, using mini-tufts, verified this phenomenon for the present configuration with undeflected leading edges. Unfortunately, the photographic quality of this particular sequence was quite poor and tuft photographs are not available.

The data of Figure 5 illustrates the effect that such vorticies have on the longitudinal aerodynamic characteristics of the configuration. As can be seen for  $\alpha = 4^\circ$ , a pronounced non-linearity in  $C_L$  and  $C_m$  versus  $\alpha$  exists. These results are consistent with previous studies, the non-linearity in  $C_L$  being termed vortex-lift and the non-linearity in  $C_m$  being termed pitch-up.

Effect of simple leading-edge deflection.- Reference 3 has shown that a simple leading-edge deflection of  $30^\circ$  is an effective means to forestall leading edge vortex separation for a similar, highly-swept arrow-wing configuration. For the present configuration figure 6(a-d) shows the effect of simply deflecting the leading-edge about the hinge-line shown in Figure 3(a), for conditions with the outboard vertical fins on and off, and  $\delta_f = 0^\circ$  and  $20^\circ$ . In as much as the higher  $R_N$  data was obtained for the configuration with  $\delta_{LE} = 0^\circ$ , only for conditons with the outboard vertical fins on, plots of  $S$  and  $L/D$  are presented for the configuration with  $\delta_{LE} = 0^\circ$ , only for conditions with the vertical fins on. However, noting that  $C_m$ ,  $C_L$ , and  $C_D$  are only slightly influenced by  $R_N$ , these data are presented for the configuration with  $\delta_{LE} = 0^\circ$  for conditions with vertical fins on and off. Comparison of the data of figure 6a with that of figure 6b, and comparision of the data of figure 6c with that of figure 6d indicates that the outboard vertical fins may provide a slight reduction in the pitch-up tendency at higher angles of attack.

Most importantly, the data of Figure 6 shows that deflecting the leading edge through either  $30^\circ$  or  $40^\circ$  is effective in delaying the angle-of-attack at which pitch-up occurs to  $\alpha \geq 8^\circ$ , and that the vortex lift increment is virtually eliminated. The data further show that for the range of lift coefficients of interest (i.e.,  $0.3 \leq C_L \leq 0.6$ ),  $\delta_{LE} = 30^\circ$  provides better performance than  $\delta_{LE} = 40^\circ$ .

Tuft photographs for the configuration with  $\delta_{LE} = 30^\circ$  are presented in Figure 7. As can be seen for  $\alpha \geq 8^\circ$  some vortex separation is apparent for the inboard wing panel, while the outboard wing panel experiences plain separation. This condition, as expected, worsens with increasing angles-of-attack.

Effect of leading-edge-slat.— The leading-edge slat tested, was designed using simple sweep theory in conjunction with two-dimensional methods. The slat design was intended to limit the normally high leading-edge suction peaks, to values for which it was considered that attached flow could be maintained. This resulted in an average value of slat gap of approximately 0.170 cm (0.067 inches) and an average value of slat overlap of approximately 0.079 cm (0.031 inches). Results for the configuration with the leading edge slat (see Fig. 3(b) for geometric details of the slat) are presented in Figure 8(a-c). The data show that for  $\delta_f = 0^\circ$  the leading-edge slat is effective in postponing the occurrence of pitch-up to  $\alpha \approx 12^\circ$  (corresponding to  $C_L \approx 0.55$ ), and that with  $\delta_f = 20^\circ$  pitch-up could also be delayed to  $C_L \approx 0.55$ . Tuft photographs for the configuration with the leading-edge slat are presented in Figure 9. Comparison with the tuft photographs for the configuration with the simple  $\delta_{LE} = 30^\circ$ , shows that the slat tends to suppress the inboard vortex separation to higher  $\alpha$ 's, but the flow over the outboard panel is essentially the same and is experiencing separation for  $\alpha \geq 8^\circ$ .



The data of Figure 8 further show that reducing the deflection of the innermost leading-edge element (slat configuration II) results in a very slight degradation in performance. This result is apparently due to a drag increment associated with the surface discontinuity inherent in non-uniformly deflecting the leading edge.

During the course of the investigation, concern arose regarding possible effects of air leakage between the intersegment joints of the multi-segmented leading edge (see Fig. 3(b)). Consequently, the intersegment joints were sealed with tape. The results presented in Figure 10 show that no intersegment leakage effects are discernible for  $\alpha \leq 14^\circ$  (i.e.,  $C_L \leq 0.6$ ); however for higher angles-of-attack (or higher  $C_L$ 's) sealing the intersegment joints had a slightly unfavorable effect on drag.

Figure 11 shows the effect of slat gap by comparing data for the configuration with the leading-edge-slat gap in the nominal condition with: (1) data for the configuration with the leading-edge slat gap increased (see Fig. 3(b)) and (2) data for the configuration with the outboard wing panel leading-edge slat gaps sealed. As can be seen, the data for the three conditions are virtually identical.

Effect of variable chord leading-edge.— The variable chord leading-edge was designed using a modified version of the analysis and design methodology presented in reference 8. Figure 12 presents the longitudinal aerodynamic characteristics of the configuration with the variable chord leading edge (see Fig. 3(c) for geometric details of the variable chord leading edge). As can be seen, deflecting the variable chord leading-edge through either  $20^\circ$  or  $40^\circ$  is only somewhat effective in forestalling pitch-up. Although, the  $40^\circ$  deflection is seen to result in a better pitching moment characteristic (relative to the  $20^\circ$

deflection) it also results in a significant performance degradation relative to the 20° deflection, at lower lift coefficients.

Tuft photographs for the configuration with the variable chord leading-edge are presented in Figure 13. As can be seen for either the 20° or the 40° deflection, vortex separation is apparent for  $\alpha \geq 4^\circ$ . These results are consistent with the force and moment data shown in Figure 12.

Comparison of leading-edge devices.- Figure 14 presents a comparison of the longitudinal aerodynamic characteristics for the leading-edge configurations considered. As can be seen, the simply deflected leading-edge with  $\delta_{LE} = 30^\circ$ , and the leading-edge slat provide improvements in longitudinal stability and performance which are similar, however, the leading-edge slat generally exhibits slightly better aerodynamic characteristics. Both of these geometries exhibit substantial improvements relative to the undeflected leading edge and the variable chord leading-edge concept.

Effect of trailing-edge flap deflection.- Figure 15 shows the effect of trailing-edge flap deflection for the configurations with the simply deflected leading edge and the leading-edge slat. As can be seen, the trailing-edge flap effectiveness is essentially the same for both configurations and remains relatively constant for the range of conditions investigated.

#### Lateral-Directional Aerodynamic Characteristics.

As noted previously, the present model was comprised of a wing-fuselage and was intended to address generic problems associated with highly swept wings. Reference 5 indicates that one of the major deficiencies of this class of highly swept wings is the excessively high levels of effective dihedral.

Effective dihedral derivative.— Figure 16 presents the variation of  $C_{l\beta}$  with  $\alpha$  and with  $C_L$  for several of the leading-edge configurations investigated. As can be seen, deflecting the leading edge has the positive effect of reducing  $C_{l\beta}$ . This result is thought to be due to the deflected leading edge effectively representing some geometric anhedral.

### Summary of Results

An investigation was conducted to provide a direct comparison of the effect of several leading-edge devices on the aerodynamic performance of a highly swept wing configuration. The results may be summarized as follows:

1. For the configuration with undeflected leading-edges, vortex separation first occurs on the outboard wing panel for angles of attack of approximately  $2^\circ$ , and wing apex vortices become apparent for  $\alpha \geq 4^\circ$ .
2. Occurrence of leading-edge vortex flows may be postponed with leading-edge devices. Of the devices considered, the most promising were the simple leading edge deflection of  $30^\circ$ , and the leading-edge slat system.
3. The trailing-edge flap effectiveness is essentially the same for the configuration with either the simple leading-edge deflection of  $30^\circ$  or the leading-edge slat system.
4. Deflecting the leading-edges downward in an attempt to postpone leading-edge vortex flows, has the positive effect of reducing the effective dihedral.

## APPENDIX A

## WIND-TUNNEL TEST SCHEDULE AND DATA TABULATION

As an aid to the reader, the appendix provides the wind-tunnel test schedule and tabulated longitudinal aerodynamic data.

TABLE AI. - TEST PROGRAM

| RUN | q,PSF | $\beta$ ,Deg | Vertical Fin | $\delta_f$ , Deg | Leading Edge       |
|-----|-------|--------------|--------------|------------------|--------------------|
| 2   | 64    | 0            | On           | 0                | Undelected         |
| 3   | 85    | 0            | On           | 0                | Undelected         |
| 4   | 107   | 0            | On           | 0                | Undelected         |
| 5   | 64    | 0            | Off          | 0                | Undelected         |
| 6   | 107   | 0            | On           | 20               | Undelected         |
| 7   | 64    | 0            | On           | 20               | Undelected         |
| 8   | 64    | 0            | Off          | 20               | Undelected         |
| 9   | 64    | -5           | Off          | 20               | Undelected         |
| 10  | 64    | -10          | Off          | 20               | Undelected         |
| 11  | 64    | 0            | Off          | 20               | Slat, IA           |
| 12  | 107   | 0            | Off          | 20               | Slat, IA           |
| 13  | 64    | 0            | On           | 20               | Slat, IA           |
| 14  | 107   | 0            | On           | 20               | Slat, IA           |
| 15  | 64    | 0            | On           | 0                | Slat, IA           |
| 16  | 64    | 0            | Off          | 0                | Slat, IA           |
| 17  | 64    | -5           | Off          | 0                | Slat, IA           |
| 18  | 64    | -10          | Off          | 0                | Slat, IA           |
| 19  | 64    | 0            | Off          | 0                | Slat, IIA          |
| 20  | 64    | 0            | On           | 0                | Slat, IIA          |
| 21  | 64    | 0            | On           | 0                | Slat, IIA          |
| 22  | 64    | 0            | Off          | 0                | Slat, IIA          |
| 23  | 64    | 0            | Off          | 0                | Slat, IA           |
| 24  | 64    | 0            | On           | 0                | Taped Intersegment |
|     |       |              |              |                  | Slat, IA           |
|     |       |              |              |                  | Taped Intersegment |
| 25  | 64    | 0            | Off          | 0                | Simple, 30°        |
| 26  | 64    | 0            | On           | 0                | Simple, 30°        |
| 27  | 64    | 0            | On           | 20               | Simple, 30°        |
| 28  | 64    | 0            | Off          | 20               | Simple, 30°        |
| 29  | 64    | -5           | Off          | 0                | Simple, 30°        |
| 30  | 64    | -10          | Off          | 0                | Simple, 30°        |
| 31  | 64    | 0            | Off          | 0                | Simple, 40°        |
| 32  | 64    | 0            | On           | 0                | Simple, 40°        |
| 33  | 64    | 0            | On           | 20               | Simple, 40°        |
| 34  | 64    | 0            | Off          | 20               | Simple, 40°        |
| 35  | 64    | -5           | Off          | 0                | Simple, 40°        |
| 36  | 64    | -10          | Off          | 0                | Simple, 40°        |

TABLE AI. - TEST PROGRAM (Concluded)

| RUN | q,PSF | $\beta$ ,Deg | Vertical Fin | $\delta_f$ , Deg | Leading Edge        |
|-----|-------|--------------|--------------|------------------|---------------------|
| 37  | 64    | 0            | Off          | 0                | Variable Chord, 20° |
| 38  | 64    | 0            | On           | 0                | Variable Chord, 20° |
| 39  | 64    | 0            | On           | 20               | Variable Chord, 20° |
| 40  | 64    | 0            | Off          | 20               | Variable Chord, 20° |
| 41  | 64    | -5           | Off          | 20               | Variable Chord, 20° |
| 42  | 64    | -10          | Off          | 20               | Variable Chord, 20° |
| 43  | 64    | 0            | Off          | 20               | Variable Chord, 40° |
| 44  | 64    | 0            | On           | 20               | Variable Chord, 40° |
| 45  | 64    | 0            | On           | 20               | Variable Chord, 40° |
| 46  | 64    | 0            | Off          | 20               | Variable Chord, 40° |
| 47  | 64    | -5           | Off          | 0                | Variable Chord, 40° |
| 48  | 64    | -10          | Off          | 0                | Variable Chord, 40° |
| 49  | 64    | 0            | Off          | 0                | Slat, IB            |
| 50  | 64    | 0            | Off          | 0                | Slat, IB            |
| 51  | 64    | 0            | On           | 0                | Slat, IB            |
| 52  | 64    | 0            | On           | 0                | Slat, IB            |
|     |       |              |              |                  | Out 'BD Gap Sealed  |
| 53  | 107   | 0            | On           | 0                | Slat, IB            |
| 54  | 64    | 0            | On           | 10               | Slat, IB            |
| 55  | 64    | 0            | On           | 20               | Slat, IB            |
| 56  | 64    | 0            | On           | 10               | Simple, 30°         |
| 57  | 64    | 0            | On           | 0                | Simple, 30°         |
| 58  | 64    | 0            | On           | 0                | Simple, 30°         |
| 59  | 64    | 0            | On           | 0                | Simple, 30°         |

TABLE AII. - TABULATED DATA

RLA 2

| ALPHA | BETA | CL     | CD    | CM     | CRM    | CYM    | CSF    |
|-------|------|--------|-------|--------|--------|--------|--------|
| 1.17  | .00  | .125P  | .0146 | .0175  | .0005  | -.0002 | .0003  |
| -5.5P | .00  | -.1374 | .020P | -.002P | .0007  | -.0002 | .0005  |
| -3.33 | .00  | -.0411 | .0125 | .0051  | .0007  | -.0002 | .0006  |
| -1.13 | .00  | .0433  | .0110 | .0122  | .0005  | -.0002 | .0004  |
| 1.12  | .00  | .125P  | .0147 | .0175  | .0004  | -.0003 | .0003  |
| 3.4P  | .00  | .21P4  | .0250 | .0235  | .0006  | -.0002 | .0001  |
| 5.69  | .00  | .32P4  | .0454 | .0346  | .0001  | -.0004 | .0001  |
| 7.97  | .00  | .4422  | .0756 | .0499  | -.0001 | -.0005 | .0003  |
| 10.31 | .00  | .55P2  | .1165 | .0689  | .0000  | -.0010 | .0003  |
| 12.5P | .00  | .6757  | .16P4 | .0549  | .0009  | -.0032 | -.0020 |
| 14.9P | -.01 | .7531  | .2319 | .12P1  | .0011  | -.005P | -.0063 |
| 1.15  | .00  | .1365  | .0145 | .0185  | .0005  | -.0003 | .000P  |

RLA 3

| ALPHA | BETA | CL     | CD    | CM     | CRM    | CYM    | CSF    |
|-------|------|--------|-------|--------|--------|--------|--------|
| 1.15  | .00  | .134P  | .0143 | .0176  | .0005  | -.0004 | -.0001 |
| -5.62 | .00  | -.1361 | .020P | -.002P | .0005  | -.0003 | .0005  |
| -3.33 | .00  | -.03P2 | .0122 | .0050  | .0007  | -.0003 | .0002  |
| -1.09 | .00  | .0475  | .0107 | .0122  | .0005  | -.0003 | .0000  |
| 1.1P  | .00  | .1324  | .0143 | .0172  | .0003  | -.0004 | .0000  |
| 3.4P  | .00  | .22P4  | .0247 | .0237  | .0002  | -.0003 | .0000  |
| 5.04  | .00  | .3422  | .0441 | .0348  | -.0002 | -.0006 | -.0005 |
| 8.1P  | .00  | .4617  | .07P4 | .0525  | -.0003 | -.0007 | -.0004 |
| 10.5P | .00  | .5P47  | .1225 | .0739  | .0000  | -.0015 | -.0009 |
| 12.0P | -.02 | .7059  | .177P | .1026  | .0010  | -.0042 | -.0051 |
| 15.46 | -.04 | .P6P5  | .25P3 | .126P  | .0020  | -.00P2 | -.0135 |
| 1P.01 | -.06 | 1.0265 | .3604 | .1571  | .0006  | -.0113 | -.0176 |
| 1.22  | .00  | .1444  | .0145 | .0175  | .0003  | -.0004 | .0005  |

RLA 4

| ALPHA | BETA | CL     | CD    | CM     | CRM    | CYM    | CSF    |
|-------|------|--------|-------|--------|--------|--------|--------|
| 1.25  | .00  | .1415  | .0149 | .0176  | .0004  | -.0005 | .0003  |
| -5.67 | .00  | -.1355 | .0204 | -.0033 | .0004  | -.0004 | .0007  |
| -3.34 | .00  | -.0355 | .0121 | .0052  | .0005  | -.0003 | .0004  |
| -1.0P | .00  | .0513  | .0109 | .0127  | .0005  | -.0004 | .0004  |
| 1.22  | .00  | .13P8  | .014P | .0173  | .0003  | -.0004 | .0004  |
| 3.62  | .00  | .2400  | .0263 | .0235  | .0004  | -.0004 | .0009  |
| 6.00  | .00  | .3550  | .0490 | .0362  | -.0004 | -.0007 | .0006  |
| 8.42  | .00  | .4836  | .0854 | .0556  | -.0003 | -.0009 | .0007  |
| 10.0P | .00  | .6105  | .1335 | .0P03  | .0002  | -.0022 | -.0003 |
| 1.2P  | .00  | .1454  | .0149 | .017P  | .0003  | -.0005 | .0005  |

RLA 5

| ALPHA | BETA | CL     | CD    | CM     | CRM   | CYM    | CSF    |
|-------|------|--------|-------|--------|-------|--------|--------|
| 1.17  | .00  | .1413  | .0144 | .0181  | .0005 | -.0001 | -.0005 |
| -5.53 | .00  | -.1212 | .0191 | -.0011 | .0008 | .0000  | -.0002 |
| -3.2P | .00  | -.0265 | .0115 | .0067  | .0007 | -.0001 | -.0004 |
| -1.1P | .00  | .0560  | .0103 | .0135  | .0006 | .0000  | -.0004 |
| 1.15  | .00  | .1393  | .0143 | .01P1  | .0006 | -.0001 | -.0005 |
| 3.44  | .00  | .2372  | .0262 | .0256  | .0007 | -.0003 | -.0001 |
| 5.72  | .00  | .3422  | .0482 | .0394  | .0002 | -.0002 | -.000P |
| 7.9P  | .00  | .44P2  | .07P6 | .0616  | .0002 | -.0003 | -.000P |
| 10.31 | .00  | .5562  | .1211 | .0P51  | .0004 | -.000P | -.0014 |
| 12.64 | -.01 | .670P  | .1736 | .1128  | .0016 | -.0035 | -.0046 |
| 14.97 | -.02 | .7953  | .239P | .1463  | .0031 | -.0070 | -.00P8 |
| 1.16  | .00  | .1431  | .0144 | .018P  | .0006 | -.0001 | -.000P |

TABLE AII. - CONTINUED

RUN 6

| ALPHA | BETA | CL    | CD    | CM     | CRM    | CYM    | CSF    |
|-------|------|-------|-------|--------|--------|--------|--------|
| 1.81  | .00  | .2001 | .0369 | -.0156 | .0002  | -.0005 | .0007  |
| -5.09 | .00  | .0329 | .0214 | -.0343 | .0005  | -.0003 | -.0002 |
| -2.7e | .00  | .1204 | .0204 | -.0242 | .0004  | -.0003 | -.0002 |
| -.51  | .00  | .2057 | .0255 | -.0185 | .0005  | -.0004 | -.0003 |
| 1.81  | .00  | .2997 | .0365 | -.0154 | .0002  | -.0005 | -.0003 |
| 4.18  | .00  | .4069 | .0565 | -.0081 | .0000  | -.0003 | -.0002 |
| 6.54  | .00  | .5289 | .0884 | .0069  | -.0004 | -.0007 | -.0007 |
| 9.06  | .00  | .6646 | .1352 | .0264  | -.0005 | -.0007 | .0003  |
| 11.51 | .00  | .7929 | .1931 | .0506  | -.0001 | -.0024 | -.0005 |
| 13.90 | -.03 | .9288 | .2679 | .0867  | .0007  | -.0058 | -.0079 |
| 1.84  | .00  | .3092 | .0373 | -.0151 | .0001  | -.0005 | .0001  |

RUN 7

| ALPHA | BETA | CL     | CD    | CM     | CRM    | CYM    | CSF    |
|-------|------|--------|-------|--------|--------|--------|--------|
| 1.58  | .00  | .2978  | .0356 | -.0147 | .0003  | -.0004 | .0000  |
| -5.11 | .00  | .0425  | .0206 | -.0323 | .0007  | -.0002 | .0001  |
| -2.88 | .00  | .1253  | .0200 | -.0227 | .0005  | -.0002 | -.0001 |
| -.69  | .00  | .2060  | .0246 | -.0176 | .0005  | -.0002 | -.0002 |
| 1.58  | .00  | .2978  | .0354 | -.0149 | .0002  | -.0004 | -.0001 |
| 3.87  | .00  | .4009  | .0549 | -.0060 | .0000  | -.0004 | -.0003 |
| 6.18  | .00  | .5119  | .0834 | .0073  | -.0002 | -.0004 | -.0003 |
| 8.48  | .00  | .6296  | .1229 | .0223  | -.0003 | -.0006 | .0001  |
| 10.84 | .00  | .7512  | .1744 | .0415  | -.0003 | -.0014 | -.0002 |
| 13.19 | -.01 | .8679  | .2365 | .0694  | .0002  | -.0044 | -.0034 |
| 15.48 | -.01 | .9729  | .3070 | .1082  | -.0006 | -.0063 | -.0062 |
| 17.75 | -.02 | 1.0687 | .3855 | .1532  | -.0032 | -.0086 | -.0051 |
| 1.59  | .00  | .3015  | .0357 | -.0145 | .0002  | -.0003 | -.0002 |

RUN 8

| ALPHA | BETA | CL     | CD    | CM     | CRM   | CYM    | CSF    |
|-------|------|--------|-------|--------|-------|--------|--------|
| 1.58  | .00  | .2988  | .0354 | -.0146 | .0004 | -.0002 | -.0004 |
| -5.10 | .00  | .0430  | .0206 | -.0323 | .0007 | -.0001 | -.0003 |
| -2.88 | .00  | .1253  | .0198 | -.0227 | .0006 | -.0001 | -.0002 |
| -.68  | .00  | .2070  | .0242 | -.0177 | .0007 | .0000  | -.0007 |
| 1.59  | .00  | .2987  | .0355 | -.0148 | .0003 | -.0002 | -.0004 |
| 3.91  | .00  | .4078  | .0562 | -.0059 | .0001 | -.0002 | -.0004 |
| 6.19  | .00  | .5140  | .0860 | .0102  | .0000 | -.0002 | -.0005 |
| 8.48  | .00  | .6248  | .1264 | .0295  | .0000 | -.0003 | -.0003 |
| 10.83 | .00  | .7462  | .1799 | .0504  | .0001 | -.0009 | -.0014 |
| 13.21 | -.01 | .8747  | .2455 | .0757  | .0013 | -.0038 | -.0043 |
| 15.55 | -.02 | 1.0066 | .3251 | .1095  | .0030 | -.0067 | -.0079 |
| 17.90 | -.03 | 1.1277 | .4145 | .1499  | .0007 | -.0076 | -.0120 |
| 1.61  | .00  | .3027  | .0357 | -.0146 | .0003 | -.0002 | -.0007 |

RUN 9

| ALPHA | BETA | CL     | CD    | CM     | CRM   | CYM    | CSF    |
|-------|------|--------|-------|--------|-------|--------|--------|
| 1.61  | 5.01 | .3025  | .0360 | -.0122 | .0064 | .0042  | -.0227 |
| -5.09 | 5.01 | .0478  | .0216 | -.0338 | .0005 | .0047  | .0023  |
| -2.88 | 5.01 | .1267  | .0208 | -.0232 | .0023 | .0040  | -.0062 |
| -.67  | 5.01 | .2085  | .0252 | -.0183 | .0045 | .0039  | -.0126 |
| 1.59  | 5.01 | .3010  | .0368 | -.0126 | .0065 | .0041  | -.0226 |
| 3.90  | 5.00 | .4025  | .0562 | -.0028 | .0091 | .0043  | -.0347 |
| 6.19  | 5.00 | .5128  | .0867 | .0131  | .0110 | .0034  | -.0442 |
| 8.48  | 5.00 | .6294  | .1270 | .0336  | .0128 | .0017  | -.0556 |
| 10.86 | 4.99 | .7542  | .1812 | .0582  | .0145 | -.0009 | -.0702 |
| 13.25 | 4.98 | .8754  | .2470 | .0859  | .0174 | -.0045 | -.0866 |
| 15.57 | 4.97 | 1.0102 | .3255 | .1171  | .0187 | -.0075 | -.1032 |
| 15.94 | 4.97 | 1.1401 | .3958 | .1559  | .0162 | -.0093 | -.1180 |

TABLE AII. - CONTINUED

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PWA 10

| ALPHA | BETA  | CL    | CD    | CM     | CPM    | CYM    | CSF    |
|-------|-------|-------|-------|--------|--------|--------|--------|
| 1.62  | 10.02 | .3141 | .0395 | -.0023 | .0130  | .0100  | -.0446 |
| -5.09 | 10.04 | .0486 | .0246 | -.0330 | -.0011 | .0111  | .0083  |
| -2.86 | 10.03 | .1316 | .0236 | -.0210 | .0037  | .0099  | -.0088 |
| -.66  | 10.03 | .2192 | .0279 | -.0114 | .0086  | .0096  | -.0250 |
| 1.62  | 10.02 | .3128 | .0394 | -.0026 | .0130  | .0099  | -.0445 |
| 3.92  | 10.01 | .4110 | .0508 | .0090  | .0175  | .0094  | -.0660 |
| 6.19  | 10.01 | .5145 | .0876 | .0274  | .0198  | .0083  | -.0877 |
| 8.51  | 10.00 | .6369 | .1264 | .0507  | .0231  | .0053  | -.1107 |
| 10.85 | 9.99  | .7592 | .1823 | .0806  | .0261  | -.0001 | -.1386 |
| 13.11 | 9.98  | .8373 | .2353 | .1187  | .0202  | -.0029 | -.1571 |
| 15.38 | 9.98  | .9394 | .3038 | .1541  | .0168  | -.0053 | -.1759 |
| 1.64  | 10.02 | .3164 | .0395 | -.0021 | .0135  | .0099  | -.0458 |

PWA 11

| ALPHA | BETA | CL    | CD    | CM     | CPM    | CYM    | CSF    |
|-------|------|-------|-------|--------|--------|--------|--------|
| 1.50  | .00  | .2695 | .0334 | -.0215 | .0003  | -.0001 | .0008  |
| -5.18 | .00  | .0148 | .0369 | -.0571 | .0007  | -.0003 | .0003  |
| -2.94 | .00  | .1045 | .0307 | -.0439 | .0006  | -.0002 | .0005  |
| -.77  | .00  | .1962 | .0296 | -.0324 | .0004  | -.0002 | .0009  |
| 1.51  | .00  | .2671 | .0335 | -.0219 | .0003  | -.0001 | .0010  |
| 3.75  | .00  | .3470 | .0412 | -.0142 | .0001  | -.0003 | .0008  |
| 5.95  | .00  | .4274 | .0536 | -.0081 | .0000  | -.0004 | .0007  |
| 8.16  | .00  | .5127 | .0725 | -.0023 | -.0007 | -.0004 | .0003  |
| 10.42 | .00  | .5992 | .0994 | .0058  | -.0005 | -.0013 | -.0016 |
| 12.64 | -.01 | .6712 | .1320 | .0211  | -.0013 | -.0039 | -.0045 |
| 14.86 | -.02 | .7574 | .1757 | .0345  | -.0003 | -.0055 | -.0107 |
| 17.12 | -.02 | .8466 | .2301 | .0514  | -.0041 | -.0090 | -.0079 |
| 19.40 | -.01 | .9423 | .2964 | .0705  | -.0068 | -.0097 | -.0040 |
| 1.50  | .00  | .2695 | .0334 | -.0214 | .0003  | -.0001 | .0019  |

PWA 12

| ALPHA | BETA | CL     | CD    | CM     | CPM    | CYM    | CSF    |
|-------|------|--------|-------|--------|--------|--------|--------|
| 1.68  | .00  | .2678  | .0335 | -.0223 | .0002  | -.0004 | -.0009 |
| -5.24 | .00  | -.0005 | .0389 | -.0603 | .0003  | -.0002 | -.0005 |
| -2.91 | .00  | .0940  | .0315 | -.0460 | .0004  | -.0002 | -.0008 |
| -.64  | .00  | .1827  | .0302 | -.0336 | .0002  | -.0004 | -.0008 |
| 1.67  | .00  | .2672  | .0339 | -.0223 | .0002  | -.0005 | -.0005 |
| 3.99  | .00  | .3509  | .0422 | -.0142 | -.0001 | -.0005 | -.0010 |
| 6.27  | .00  | .4355  | .0554 | -.0079 | -.0002 | -.0005 | -.0011 |
| 8.55  | -.01 | .5269  | .0762 | -.0013 | -.0009 | -.0005 | -.0015 |
| 10.89 | -.02 | .6183  | .1057 | .0077  | -.0011 | -.0018 | -.0043 |
| 13.20 | -.04 | .6966  | .1425 | .0263  | -.0010 | -.0044 | -.0098 |
| 15.50 | -.07 | .7546  | .1934 | .0414  | -.0012 | -.0070 | -.0181 |
| 17.84 | -.09 | .8980  | .2577 | .0612  | -.0025 | -.0051 | -.0216 |
| 20.37 | -.07 | 1.0260 | .3459 | .0816  | -.0072 | -.0018 | -.0182 |
| 1.73  | .00  | .2605  | .0337 | -.0208 | .0003  | -.0004 | -.0007 |

PWA 13

| ALPHA | BETA | CL    | CD    | CM     | CPM    | CYM    | CSF    |
|-------|------|-------|-------|--------|--------|--------|--------|
| 1.52  | .00  | .2722 | .0341 | -.0206 | .0000  | -.0002 | .0002  |
| -5.18 | .00  | .0187 | .0370 | -.0566 | .0006  | -.0004 | -.0001 |
| -2.93 | .00  | .1089 | .0306 | -.0430 | .0005  | -.0003 | -.0001 |
| -.74  | .00  | .1906 | .0301 | -.0317 | .0002  | -.0003 | .0001  |
| 1.48  | .00  | .2705 | .0337 | -.0208 | .0000  | -.0003 | .0003  |
| 3.72  | .00  | .3489 | .0418 | -.0134 | -.0001 | -.0004 | -.0001 |
| 5.93  | .00  | .4291 | .0543 | -.0074 | -.0003 | -.0006 | -.0003 |
| 8.15  | .00  | .5145 | .0735 | -.0015 | -.0009 | -.0007 | -.0013 |
| 10.38 | -.01 | .6031 | .0995 | .0234  | -.0009 | -.0013 | -.0033 |
| 12.59 | -.01 | .6606 | .1291 | .0045  | .0051  | .0047  | -.0064 |
| 14.70 | -.03 | .7185 | .1667 | .0458  | -.0011 | -.0072 | -.0133 |
| 16.92 | -.03 | .7561 | .2157 | .0637  | -.0034 | -.0100 | -.0131 |
| 19.20 | -.02 | .8957 | .2802 | .0818  | -.0052 | -.0075 | -.0077 |
| 1.45  | .00  | .2687 | .0337 | -.0208 | .0002  | -.0002 | .0005  |



RUN 14

| ALPHA | BETA | CL    | CD    | CM     | CPM    | CYM    | CSF    |
|-------|------|-------|-------|--------|--------|--------|--------|
| 1.6P  | .00  | .2722 | .0345 | -.020P | .0003  | -.0005 | -.0007 |
| -5.14 | .00  | .0069 | .0385 | -.0586 | .0004  | -.0003 | .0002  |
| -2.49 | .00  | .1000 | .0316 | -.0450 | .0004  | -.0003 | -.0001 |
| -.65  | .00  | .1871 | .0306 | -.0326 | .0003  | -.0005 | -.0004 |
| 1.65  | .00  | .2709 | .0347 | -.0211 | .0001  | -.0005 | -.0002 |
| 3.97  | .00  | .3536 | .0432 | -.0133 | -.0002 | -.0005 | -.0005 |
| 6.25  | .00  | .4292 | .0567 | -.0065 | -.0003 | -.0006 | -.0001 |
| 8.55  | -.01 | .5310 | .0775 | -.0003 | -.0008 | -.0007 | -.0016 |
| 10.07 | -.02 | .6254 | .1064 | .0068  | -.0014 | -.0013 | -.0044 |
| 13.04 | -.04 | .6652 | .1372 | .0335  | -.0022 | -.0037 | -.0096 |
| 15.30 | -.0P | .7499 | .1822 | .0541  | -.0022 | -.0043 | -.0190 |
| 17.65 | -.09 | .8492 | .242P | .0739  | -.0029 | -.0092 | -.022P |
| 20.10 | -.16 | .9731 | .2247 | .089P  | -.0060 | -.0033 | -.0245 |
| 1.70  | .00  | .2762 | .0346 | -.0203 | .0001  | -.0006 | -.0002 |

RUN 15

| ALPHA | BETA | CL     | CD    | CM     | CPM    | CYM    | CSF    |
|-------|------|--------|-------|--------|--------|--------|--------|
| 1.12  | .00  | .1317  | .0177 | .00E1  | .0006  | -.0002 | -.0002 |
| -5.62 | .00  | -.1480 | .0381 | -.0265 | .0006  | -.0005 | -.0007 |
| -3.39 | .00  | -.0541 | .0242 | -.0131 | .0010  | -.0004 | -.0011 |
| -1.15 | .00  | .0403  | .0188 | -.0020 | .000P  | -.0003 | -.000P |
| 1.14  | .00  | .1297  | .0180 | .00P0  | .0006  | -.0003 | -.0002 |
| 3.37  | .00  | .2125  | .0212 | .0159  | .0004  | -.0003 | -.0006 |
| 5.56  | .00  | .2915  | .0291 | .0222  | .0001  | -.0004 | -.0011 |
| 7.75  | .00  | .3741  | .0412 | .0287  | .0000  | -.0007 | -.0016 |
| 10.00 | -.01 | .4600  | .0609 | .0348  | -.0003 | -.0014 | -.0039 |
| 12.25 | -.02 | .5467  | .0878 | .0419  | -.000P | -.0029 | -.0085 |
| 14.42 | -.03 | .6062  | .1177 | .0643  | -.0041 | -.0059 | -.0118 |
| 16.53 | -.02 | .65P5  | .1567 | .0909  | -.0035 | -.00P1 | -.0107 |
| 18.82 | -.02 | .75P0  | .2140 | .1094  | -.0059 | -.00P4 | -.0072 |
| 1.10  | .00  | .1312  | .0175 | .00E2  | .0005  | -.0002 | -.0005 |

RUN 16

| ALPHA | BETA | CL     | CD    | CM     | CPM    | CYM    | CSF    |
|-------|------|--------|-------|--------|--------|--------|--------|
| 1.10  | .00  | .1304  | .0170 | .0079  | .0005  | .0000  | -.0002 |
| -5.01 | .00  | -.1479 | .0377 | -.0262 | .000P  | -.0004 | -.000P |
| -5.61 | .00  | -.14P1 | .0376 | -.0263 | .000P  | -.0004 | -.0006 |
| -3.37 | .00  | -.0532 | .0247 | -.0130 | .0010  | -.0003 | -.0010 |
| -1.13 | .00  | .0424  | .0185 | -.0017 | .000P  | -.0002 | -.0009 |
| 1.04  | .00  | .1278  | .0174 | .0077  | .0006  | -.0001 | -.0004 |
| 3.36  | .00  | .2120  | .0202 | .0152  | .0004  | -.0001 | -.000P |
| 5.57  | .00  | .2920  | .0280 | .0216  | .0001  | -.0003 | -.0010 |
| 7.74  | .00  | .3729  | .0369 | .0281  | .0000  | -.0005 | -.0014 |
| 10.01 | -.01 | .4600  | .0600 | .0357  | -.0003 | -.0015 | -.0039 |
| 12.25 | -.02 | .5427  | .0877 | .0449  | -.0016 | -.0030 | -.0067 |
| 14.43 | -.03 | .6190  | .1229 | .0629  | -.0005 | -.0044 | -.0116 |
| 16.67 | -.02 | .7002  | .1686 | .0820  | -.0044 | -.00P2 | -.0092 |
| 18.92 | -.01 | .7573  | .2276 | .1017  | -.0060 | -.0090 | -.0056 |
| 1.14  | .00  | .1336  | .0173 | .00E2  | .0006  | .0000  | -.0005 |

RUN 17

| ALPHA | BETA | CL     | CD    | CM     | CPM    | CYM   | CSF    |
|-------|------|--------|-------|--------|--------|-------|--------|
| 1.14  | 5.03 | .1334  | .0194 | .0069  | .0023  | .00E2 | .0014  |
| -5.60 | 5.05 | -.1436 | .0407 | -.0263 | -.0035 | .0108 | .0332  |
| -3.36 | 5.04 | -.0474 | .0271 | -.0135 | -.0007 | .0101 | .0209  |
| -1.13 | 5.03 | .0464  | .0205 | -.002P | .0007  | .0094 | .0107  |
| 1.10  | 5.03 | .1315  | .0194 | .0066  | .0022  | .00E2 | .0016  |
| 3.37  | 5.03 | .2143  | .0229 | .0146  | .0041  | .0070 | -.0053 |
| 5.60  | 5.04 | .2954  | .0302 | .0224  | .0055  | .0065 | -.0104 |
| 7.78  | 5.04 | .3795  | .042P | .0300  | .0069  | .0073 | -.0177 |
| 10.03 | 5.03 | .4672  | .0639 | .03P9  | .0095  | .00P3 | -.0297 |
| 12.26 | 5.00 | .5455  | .0913 | .0540  | .0139  | .0078 | -.0467 |
| 14.44 | 4.9P | .6236  | .1270 | .0729  | .0166  | .0047 | -.0632 |
| 16.73 | 4.9P | .71P6  | .1762 | .0895  | .0116  | .0049 | -.0726 |
| 19.00 | 4.99 | .8100  | .2368 | .1072  | .0071  | .0063 | -.0780 |

RUN 18

| ALPHA | BETA  | CL     | CD    | CM     | CRM    | CYM   | CSF    |
|-------|-------|--------|-------|--------|--------|-------|--------|
| 1.12  | 10.07 | .1384  | .0248 | .0073  | .0036  | .0186 | .0057  |
| -5.57 | 10.10 | -.1319 | .0471 | -.0274 | -.0072 | .0236 | .0665  |
| -3.32 | 10.08 | -.0331 | .0335 | -.0146 | -.0029 | .0214 | .0431  |
| -1.11 | 10.07 | .0565  | .0262 | -.0032 | -.0001 | .0198 | .0219  |
| 1.10  | 10.07 | .1262  | .0248 | .0072  | .0035  | .0184 | .0059  |
| 3.36  | 10.07 | .2220  | .0287 | .0180  | .0075  | .0178 | -.0082 |
| 5.65  | 10.07 | .3063  | .0377 | .0283  | .0116  | .0182 | -.0240 |
| 7.83  | 10.05 | .3974  | .0533 | .0397  | .0161  | .0206 | -.0464 |
| 10.02 | 10.02 | .4856  | .0735 | .0547  | .0221  | .0201 | -.0769 |
| 12.35 | 10.01 | .5776  | .1055 | .0720  | .0234  | .0189 | -.0990 |
| 14.57 | 10.00 | .6648  | .1448 | .0889  | .0205  | .0174 | -.1153 |
| 16.84 | 10.00 | .7612  | .1950 | .1101  | .0186  | .0186 | -.1376 |
| 19.11 | 0.98  | .8593  | .2554 | .1351  | .0137  | .0153 | -.1627 |
| 1.12  | 10.06 | .1378  | .0245 | .0075  | .0036  | .0184 | .0039  |

RUN 19

| ALPHA | BETA | CL     | CD    | CM     | CRM    | CYM    | CSF    |
|-------|------|--------|-------|--------|--------|--------|--------|
| 1.11  | .00  | .1302  | .0164 | .0094  | .0007  | -.0002 | -.0007 |
| -5.62 | .00  | -.1480 | .0377 | -.0250 | .0008  | -.0002 | -.0004 |
| -3.37 | .00  | -.0545 | .0247 | -.0108 | .0008  | -.0002 | -.0004 |
| -1.14 | .00  | .0405  | .0182 | .0008  | .0009  | -.0001 | -.0006 |
| 1.11  | .00  | .1252  | .0167 | .0094  | .0007  | -.0001 | -.0006 |
| 3.37  | .00  | .2106  | .0202 | .0167  | .0003  | -.0002 | -.0006 |
| 5.56  | .00  | .2892  | .0279 | .0235  | .0002  | -.0003 | -.0007 |
| 7.79  | .00  | .3742  | .0405 | .0304  | .0002  | -.0008 | -.0015 |
| 10.02 | -.01 | .4585  | .0606 | .0386  | -.0003 | -.0015 | -.0032 |
| 12.27 | -.02 | .5463  | .0898 | .0493  | -.0010 | -.0037 | -.0083 |
| 14.46 | -.03 | .6212  | .1250 | .0680  | -.0004 | -.0049 | -.0109 |
| 16.66 | -.01 | .7000  | .1710 | .0894  | -.0045 | -.0055 | -.0062 |
| 19.95 | .01  | .7864  | .2321 | .1134  | -.0086 | -.0053 | .0060  |
| 1.12  | .00  | .1321  | .0160 | .0099  | .0006  | -.0002 | .0005  |

RUN 20

| ALPHA | BETA | CL     | CD    | CM     | CRM    | CYM    | CSF    |
|-------|------|--------|-------|--------|--------|--------|--------|
| 1.12  | .00  | .1220  | .0172 | .0097  | .0007  | -.0003 | -.0001 |
| -5.61 | .00  | -.1460 | .0378 | -.0243 | .0008  | -.0002 | -.0001 |
| -3.36 | .00  | -.0540 | .0253 | -.0103 | .0010  | -.0002 | -.0002 |
| -1.13 | .00  | .0411  | .0187 | .0010  | .0008  | -.0002 | -.0001 |
| 1.14  | .00  | .1200  | .0174 | .0096  | .0007  | -.0002 | -.0000 |
| 3.36  | .00  | .2097  | .0211 | .0171  | .0004  | -.0003 | -.0001 |
| 5.54  | .00  | .2900  | .0292 | .0242  | .0001  | -.0005 | -.0004 |
| 7.77  | .00  | .3725  | .0416 | .0309  | .0002  | -.0008 | -.0011 |
| 10.01 | -.01 | .4592  | .0616 | .0380  | -.0002 | -.0017 | -.0025 |
| 12.29 | -.02 | .5491  | .0898 | .0466  | -.0004 | -.0031 | -.0093 |
| 14.43 | -.02 | .6072  | .1201 | .0697  | -.0040 | -.0037 | -.0096 |
| 16.68 | -.02 | .6612  | .1607 | .0987  | -.0038 | -.0043 | -.0078 |
| 19.84 | .01  | .7554  | .2187 | .1206  | -.0078 | -.0043 | .0037  |
| 1.10  | .00  | .1312  | .0170 | .0099  | .0006  | -.0003 | .0005  |

RUN 21

| ALPHA | BETA | CL     | CD    | CM     | CRM    | CYM    | CSF    |
|-------|------|--------|-------|--------|--------|--------|--------|
| 1.12  | .00  | .1309  | .0170 | .0097  | .0007  | -.0003 | -.0003 |
| -5.63 | .00  | -.1493 | .0378 | -.0247 | .0010  | -.0002 | -.0003 |
| -3.38 | .00  | -.0552 | .0247 | -.0110 | .0011  | -.0003 | -.0003 |
| -1.14 | .00  | .0404  | .0182 | .0004  | .0010  | -.0003 | -.0004 |
| 1.11  | .00  | .1258  | .0170 | .0096  | .0007  | -.0003 | -.0002 |
| 3.37  | .00  | .2107  | .0207 | .0173  | .0004  | -.0004 | -.0004 |
| 5.57  | .00  | .2900  | .0284 | .0243  | .0003  | -.0005 | -.0008 |
| 7.77  | .00  | .3756  | .0410 | .0307  | .0002  | -.0008 | -.0016 |
| 10.04 | -.01 | .4664  | .0621 | .0361  | .0000  | -.0015 | -.0041 |
| 12.29 | -.02 | .5486  | .0892 | .0480  | -.0012 | -.0029 | -.0093 |
| 14.45 | -.02 | .6172  | .1237 | .0723  | -.0027 | -.0037 | -.0101 |
| 16.68 | -.02 | .6956  | .1725 | .0994  | -.0034 | -.0058 | -.0073 |
| 19.02 | -.01 | .8186  | .2426 | .1229  | -.0059 | -.0032 | -.0027 |
| 1.12  | .00  | .1328  | .0166 | .0099  | .0006  | -.0003 | .0001  |

RUN 22

| ALPHA | BETA | CL     | CD    | CM     | CRM    | CYM    | CSF    |
|-------|------|--------|-------|--------|--------|--------|--------|
| 1.12  | .00  | .1320  | .0162 | .0097  | .0007  | -.0001 | -.0004 |
| -5.63 | .00  | -.1480 | .0372 | -.0245 | .0010  | -.0001 | -.0006 |
| -3.39 | .00  | -.0537 | .0242 | -.0108 | .0012  | -.0002 | -.0007 |
| -1.15 | .00  | .0416  | .0176 | .0008  | .0009  | -.0002 | -.0004 |
| 1.10  | .00  | .1296  | .0163 | .0095  | .0007  | -.0001 | -.0004 |
| 3.38  | .00  | .2116  | .0199 | .0170  | .0003  | -.0002 | -.0002 |
| 5.57  | .00  | .2898  | .0274 | .0235  | .0002  | -.0004 | -.0009 |
| 7.79  | .00  | .3748  | .0398 | .0301  | .0000  | -.0009 | -.0016 |
| 10.01 | -.01 | .4621  | .0605 | .0374  | -.0002 | -.0014 | -.0031 |
| 12.27 | -.02 | .5414  | .0892 | .0526  | -.0005 | -.0048 | -.0093 |
| 14.51 | -.03 | .6435  | .1338 | .0668  | -.0002 | -.0034 | -.0114 |
| 16.81 | -.02 | .7453  | .1890 | .0869  | -.0044 | -.0050 | -.0066 |
| 19.16 | .00  | .8666  | .2626 | .1121  | -.0076 | -.0021 | -.0006 |
| 1.12  | .00  | .1328  | .0162 | .0099  | .0007  | -.0002 | -.0006 |

RUN 23

| ALPHA | BETA | CL     | CD    | CM     | CRM    | CYM    | CSF    |
|-------|------|--------|-------|--------|--------|--------|--------|
| 1.15  | .00  | .1285  | .0170 | .0077  | .0006  | -.0002 | -.0004 |
| -5.60 | .00  | -.1489 | .0373 | -.0266 | .0008  | -.0003 | -.0006 |
| -3.33 | .00  | -.0448 | .0245 | -.0121 | .0011  | -.0002 | -.0001 |
| -1.12 | .00  | .0461  | .0185 | -.0021 | .0010  | -.0002 | -.0000 |
| 1.13  | .00  | .1265  | .0168 | .0076  | .0006  | -.0003 | -.0004 |
| 3.38  | .00  | .2112  | .0201 | .0153  | .0004  | -.0002 | -.0004 |
| 5.59  | .00  | .2855  | .0275 | .0217  | .0002  | -.0003 | -.0010 |
| 7.82  | .00  | .3799  | .0413 | .0281  | .0000  | -.0005 | -.0006 |
| 10.01 | -.01 | .4580  | .0595 | .0344  | -.0002 | -.0013 | -.0029 |
| 12.28 | -.01 | .5386  | .0872 | .0478  | -.0015 | -.0040 | -.0058 |
| 14.53 | -.02 | .6394  | .1298 | .0598  | -.0006 | -.0058 | -.0059 |
| 16.78 | -.02 | .7388  | .1829 | .0754  | -.0035 | -.0069 | -.0107 |
| 19.10 | -.02 | .8453  | .2457 | .0934  | -.0067 | -.0058 | -.0068 |
| 1.15  | .00  | .1304  | .0167 | .0083  | .0006  | -.0001 | .0004  |

RUN 24

| ALPHA | BETA | CL     | CD    | CM     | CRM    | CYM    | CSF    |
|-------|------|--------|-------|--------|--------|--------|--------|
| 1.15  | .00  | .1296  | .0177 | .0081  | .0005  | -.0003 | -.0004 |
| -5.59 | .00  | -.1490 | .0379 | -.0270 | .0008  | -.0004 | -.0005 |
| -3.32 | .00  | -.0557 | .0249 | -.0137 | .0008  | -.0005 | -.0007 |
| -1.14 | .00  | .0381  | .0187 | -.0024 | .0007  | -.0004 | -.0004 |
| 1.15  | .00  | .1274  | .0179 | .0076  | .0005  | -.0003 | -.0002 |
| 3.39  | .00  | .2106  | .0213 | .0156  | .0002  | -.0003 | -.0004 |
| 5.60  | .00  | .2901  | .0290 | .0220  | .0001  | -.0004 | -.0012 |
| 7.78  | .00  | .3733  | .0411 | .0284  | -.0001 | -.0007 | -.0017 |
| 10.04 | -.01 | .4632  | .0613 | .0334  | -.0006 | -.0012 | -.0036 |
| 12.28 | -.02 | .5467  | .0874 | .0432  | -.0019 | -.0033 | -.0080 |
| 14.45 | -.02 | .6130  | .1206 | .0657  | -.0032 | -.0061 | -.0088 |
| 16.66 | -.02 | .6901  | .1673 | .0896  | -.0034 | -.0075 | -.0105 |
| 18.98 | -.02 | .7928  | .2243 | .1083  | -.0055 | -.0070 | -.0072 |
| 1.13  | .00  | .1269  | .0177 | .0080  | .0004  | -.0003 | -.0002 |

RUN 25

| ALPHA | BETA | CL     | CD    | CM     | CRM    | CYM    | CSF    |
|-------|------|--------|-------|--------|--------|--------|--------|
| 1.10  | .00  | .1180  | .0141 | .0139  | .0009  | -.0001 | -.0007 |
| -5.66 | .00  | -.1750 | .0377 | -.0094 | .0011  | .0001  | -.0007 |
| -3.36 | .00  | -.0600 | .0244 | .0022  | .0014  | .0001  | -.0007 |
| -1.16 | .00  | .0277  | .0176 | .0097  | .0010  | -.0002 | -.0003 |
| 1.11  | .00  | .1213  | .0145 | .0138  | .0008  | -.0001 | -.0003 |
| 3.37  | .00  | .2013  | .0171 | .0176  | .0005  | -.0003 | -.0005 |
| 5.56  | .00  | .2736  | .0246 | .0256  | .0004  | -.0003 | -.0010 |
| 7.74  | .00  | .3542  | .0378 | .0347  | .0005  | -.0003 | -.0016 |
| 10.02 | -.01 | .4466  | .0586 | .0421  | .0007  | -.0013 | -.0031 |
| 12.29 | -.02 | .5455  | .0917 | .0553  | .0009  | -.0031 | -.0085 |
| 14.52 | -.03 | .6332  | .1310 | .0782  | .0004  | -.0053 | -.0128 |
| 16.75 | -.03 | .7164  | .1786 | .0996  | -.0021 | -.0077 | -.0139 |
| 19.08 | .00  | .8262  | .2474 | .1225  | -.0068 | -.0052 | -.0006 |
| 1.11  | .00  | .1194  | .0138 | .0139  | .0008  | -.0001 | -.0003 |

RUN 26

| ALPHA | BETA | CL     | CD    | CM     | CRM    | CYM    | CSF    |
|-------|------|--------|-------|--------|--------|--------|--------|
| 1.11  | .00  | .1205  | .0148 | .0140  | .0007  | -.0002 | .0000  |
| -5.66 | .00  | -.1739 | .0381 | -.0100 | .0011  | -.0001 | -.0001 |
| -3.42 | .00  | -.0806 | .0248 | .0021  | .0013  | -.0002 | -.0004 |
| -1.18 | .00  | .0200  | .0172 | .0100  | .0008  | -.0004 | -.0001 |
| 1.13  | .00  | .1188  | .0145 | .0139  | .0007  | -.0004 | -.0001 |
| 3.36  | .00  | .2032  | .0182 | .0176  | .0005  | -.0004 | -.0000 |
| 5.57  | .00  | .2786  | .0260 | .0245  | .0002  | -.0004 | -.0008 |
| 7.76  | .00  | .3613  | .0389 | .0323  | .0003  | -.0006 | -.0010 |
| 10.04 | -.01 | .4539  | .0592 | .0402  | .0003  | -.0013 | -.0022 |
| 12.32 | -.02 | .5565  | .0903 | .0497  | .0006  | -.0033 | -.0075 |
| 14.57 | -.03 | .6489  | .1288 | .0677  | .0002  | -.0071 | -.0115 |
| 16.84 | -.03 | .7460  | .1780 | .0848  | -.0023 | -.0085 | -.0128 |
| 19.15 | -.01 | .8535  | .2439 | .1061  | -.0060 | -.0646 | -.0027 |

RUN 27

| ALPHA | BETA | CL     | CD    | CM     | CRM    | CYM    | CSF    |
|-------|------|--------|-------|--------|--------|--------|--------|
| 1.55  | .00  | .2734  | .0321 | -.0188 | .0004  | -.0004 | .0003  |
| -5.20 | .00  | -.0021 | .0356 | -.0416 | .0009  | -.0002 | .0003  |
| -2.97 | .00  | .0862  | .0290 | -.0304 | .0006  | -.0002 | .0003  |
| -.74  | .00  | .1755  | .0278 | -.0229 | .0007  | -.0004 | .0002  |
| 1.52  | .00  | .2701  | .0319 | -.0188 | .0005  | -.0005 | .0005  |
| 3.75  | .00  | .3503  | .0412 | -.0134 | .0001  | -.0004 | .0004  |
| 5.99  | .00  | .4317  | .0541 | -.0083 | -.0001 | -.0005 | .0002  |
| 8.18  | .00  | .5178  | .0729 | -.0012 | .0001  | -.0007 | -.0010 |
| 10.46 | .00  | .6075  | .0995 | .0076  | -.0007 | -.0015 | -.0015 |
| 12.77 | -.02 | .7135  | .1389 | .0195  | -.0001 | -.0043 | -.0071 |
| 14.95 | -.02 | .7852  | .1820 | .0400  | -.0015 | -.0051 | -.0096 |
| 17.22 | -.02 | .8827  | .2377 | .0606  | -.0029 | -.0071 | -.0137 |
| 19.51 | -.01 | .9841  | .3097 | .0835  | -.0040 | -.0037 | -.0036 |
| 1.54  | .00  | .2748  | .0320 | -.0185 | .0005  | -.0004 | .0005  |

RUN 28

| ALPHA | BETA | CL     | CD    | CM     | CRM    | CYM    | CSF    |
|-------|------|--------|-------|--------|--------|--------|--------|
| 1.53  | .00  | .2712  | .0305 | -.0190 | .0004  | -.0003 | -.0004 |
| -5.20 | .00  | -.0026 | .0346 | -.0415 | .0009  | .0000  | -.0007 |
| -2.97 | .00  | .0870  | .0279 | -.0305 | .0007  | -.0001 | -.0004 |
| -.75  | .00  | .1756  | .0264 | -.0235 | .0006  | -.0002 | -.0004 |
| 1.54  | .00  | .2701  | .0305 | -.0191 | .0004  | -.0003 | -.0003 |
| 3.78  | .00  | .3459  | .0394 | -.0140 | .0002  | -.0003 | -.0007 |
| 5.98  | .00  | .4257  | .0518 | -.0080 | .0000  | -.0004 | -.0009 |
| 8.18  | .00  | .5135  | .0713 | .0000  | -.0001 | -.0006 | -.0009 |
| 10.45 | .00  | .6045  | .0995 | .0101  | -.0007 | -.0014 | -.0020 |
| 12.76 | -.02 | .7106  | .1426 | .0250  | -.0003 | -.0040 | -.0078 |
| 14.95 | -.02 | .7846  | .1868 | .0505  | -.0002 | -.0053 | -.0115 |
| 17.20 | -.03 | .8782  | .2455 | .0702  | -.0032 | -.0078 | -.0129 |
| 19.52 | .00  | .9876  | .3220 | .0930  | -.0072 | -.0041 | -.0012 |
| 1.55  | .00  | .2722  | .0304 | -.0188 | .0005  | -.0003 | .0000  |

RUN 29

| ALPHA | BETA | CL     | CD    | CM     | CRM    | CYM   | CSF    |
|-------|------|--------|-------|--------|--------|-------|--------|
| 1.14  | 5.02 | .1225  | .0161 | .0131  | .0013  | .0051 | -.0012 |
| -5.65 | 5.03 | -.1671 | .0398 | -.0107 | -.0035 | .0085 | .0302  |
| -3.40 | 5.02 | -.0731 | .0256 | .0012  | -.0015 | .0076 | .0185  |
| -1.19 | 5.02 | .0258  | .0191 | .0087  | -.0006 | .0064 | .0081  |
| 1.11  | 5.02 | .1202  | .0160 | .0130  | .0012  | .0051 | -.0010 |
| 3.39  | 5.02 | .2047  | .0194 | .0193  | .0054  | .0048 | -.0087 |
| 5.58  | 5.02 | .2835  | .0273 | .0274  | .0070  | .0055 | -.0149 |
| 7.79  | 5.02 | .3673  | .0405 | .0369  | .0070  | .0065 | -.0233 |
| 10.02 | 5.01 | .4593  | .0626 | .0477  | .0083  | .0069 | -.0362 |
| 12.21 | 4.99 | .5525  | .0931 | .0628  | .0122  | .0071 | -.0534 |
| 14.54 | 4.97 | .6425  | .1342 | .0841  | .0117  | .0052 | -.0717 |
| 16.82 | 4.96 | .7471  | .1915 | .1057  | .0072  | .0018 | -.0746 |
| 19.14 | 5.01 | .8495  | .2560 | .1299  | .0034  | .0063 | -.0741 |
| 1.12  | 5.02 | .1218  | .0158 | .0132  | .0015  | .0051 | -.0022 |

RUN 30

| ALPHA | BETA  | CL     | CD    | CM     | CRM    | CYM   | CSF    |
|-------|-------|--------|-------|--------|--------|-------|--------|
| 1.12  | 10.05 | .1253  | .0202 | .0151  | .0023  | .0129 | .0005  |
| -5.60 | 10.00 | -.1488 | .0442 | -.0138 | -.0073 | .0179 | .0611  |
| -3.35 | 10.06 | -.0538 | .0286 | -.0024 | -.0046 | .0161 | .0382  |
| -1.12 | 10.06 | .0364  | .0223 | .0057  | -.0027 | .0141 | .0182  |
| 1.15  | 10.05 | .1257  | .0204 | .0150  | .0023  | .0130 | .0005  |
| 3.42  | 10.05 | .2172  | .0241 | .0246  | .0085  | .0129 | -.0174 |
| 5.65  | 10.04 | .3048  | .0334 | .0354  | .0124  | .0138 | -.0353 |
| 7.85  | 10.03 | .3940  | .0485 | .0482  | .0150  | .0164 | -.0554 |
| 10.11 | 10.00 | .4847  | .0701 | .0650  | .0188  | .0172 | -.0856 |
| 12.41 | 9.98  | .5813  | .1036 | .0813  | .0214  | .0165 | -.1117 |
| 14.66 | 9.97  | .6827  | .1476 | .1010  | .0201  | .0160 | -.1328 |
| 16.92 | 9.95  | .7812  | .2038 | .1251  | .0145  | .0175 | -.1428 |
| 19.25 | 10.00 | .8897  | .2768 | .1544  | .0093  | .0155 | -.1593 |
| 1.14  | 10.05 | .1266  | .0201 | .0154  | .0025  | .0130 | -.0005 |

RUN 31

| ALPHA | BETA | CL     | CD    | CM     | CRM    | CYM    | CSF    |
|-------|------|--------|-------|--------|--------|--------|--------|
| 1.09  | .00  | .1009  | .0171 | .0146  | .0008  | -.0002 | -.0003 |
| -5.70 | .00  | -.1864 | .0438 | -.0103 | .0009  | .0001  | -.0004 |
| -3.47 | .00  | -.0575 | .0286 | .0025  | .0010  | .0000  | -.0005 |
| -1.23 | .00  | -.0011 | .0210 | .0106  | .0009  | -.0001 | -.0003 |
| 1.05  | .00  | .0980  | .0171 | .0146  | .0008  | -.0002 | -.0003 |
| 3.35  | .00  | .1929  | .0188 | .0166  | .0006  | -.0001 | -.0002 |
| 5.57  | .00  | .2740  | .0264 | .0211  | .0002  | -.0005 | .0008  |
| 7.74  | .00  | .3500  | .0420 | .0307  | .0002  | -.0001 | -.0005 |
| 9.93  | .00  | .4210  | .0585 | .0441  | -.0001 | -.0004 | -.0020 |
| 12.23 | -.03 | .5148  | .0832 | .0542  | .0024  | -.0027 | -.0111 |
| 14.44 | -.04 | .6037  | .1207 | .0716  | .0029  | -.0057 | -.0175 |
| 16.74 | -.04 | .7002  | .1673 | .0868  | -.0028 | -.0075 | -.0179 |
| 18.96 | .01  | .7844  | .2194 | .1069  | -.0070 | -.0066 | .0043  |
| 1.09  | .00  | .1008  | .0167 | .0151  | .0008  | -.0003 | .0005  |

RUN 32

| ALPHA | BETA | CL     | CD    | CM     | CRM    | CYM    | CSF    |
|-------|------|--------|-------|--------|--------|--------|--------|
| 1.08  | .00  | .0997  | .0181 | .0147  | .0008  | -.0003 | .0000  |
| -5.69 | .00  | -.1874 | .0445 | -.0108 | .0010  | .0000  | .0000  |
| -3.44 | .00  | -.0974 | .0302 | .0021  | .0011  | -.0002 | -.0004 |
| -1.22 | .00  | -.0015 | .0216 | .0103  | .0009  | -.0002 | .0000  |
| 1.07  | .00  | .0974  | .0183 | .0145  | .0008  | -.0003 | .0000  |
| 3.33  | .00  | .1910  | .0201 | .0166  | .0006  | -.0003 | .0001  |
| 5.57  | .00  | .2758  | .0278 | .0203  | .0000  | -.0002 | .0001  |
| 7.75  | .00  | .3552  | .0424 | .0282  | -.0001 | -.0003 | -.0005 |
| 10.01 | .00  | .4345  | .0593 | .0384  | .0001  | -.0010 | -.0022 |
| 12.25 | -.02 | .5226  | .0822 | .0495  | .0019  | -.0035 | -.0105 |
| 14.50 | -.04 | .6225  | .1195 | .0613  | .0027  | -.0071 | -.0164 |
| 16.77 | -.04 | .7232  | .1651 | .0741  | -.0023 | -.0076 | -.0169 |
| 19.04 | .00  | .8119  | .2175 | .0914  | -.0057 | -.0056 | .0003  |
| 1.09  | .00  | .1010  | .0181 | .0148  | .0008  | -.0004 | -.0003 |

RUN 33

| ALPHA | BETA | CL     | CD    | CM     | CRM    | CYM    | CSF    |
|-------|------|--------|-------|--------|--------|--------|--------|
| 1.52  | .00  | .2618  | .0347 | -.0204 | .0008  | -.0004 | -.0004 |
| -5.24 | .00  | -.0152 | .0410 | -.0436 | .0010  | -.0002 | -.0001 |
| -3.02 | .00  | .0723  | .0334 | -.0318 | .0008  | -.0002 | .0001  |
| -.78  | .00  | .1642  | .0313 | -.0241 | .0008  | -.0004 | .0000  |
| 1.53  | .00  | .2602  | .0347 | -.0207 | .0007  | -.0005 | -.0003 |
| 3.77  | .00  | .3471  | .0428 | -.0171 | .0002  | -.0004 | .0003  |
| 5.97  | .00  | .4256  | .0561 | -.0125 | -.0001 | -.0003 | .0001  |
| 8.20  | .00  | .5158  | .0763 | -.0063 | -.0004 | -.0005 | -.0002 |
| 10.43 | .00  | .5857  | .0965 | .0065  | -.0002 | -.0011 | -.0018 |
| 12.69 | -.02 | .6745  | .1275 | .0175  | .0015  | -.0038 | -.0103 |
| 14.94 | -.04 | .7712  | .1710 | .0304  | .0016  | -.0075 | -.0154 |
| 17.20 | -.03 | .8652  | .2230 | .0470  | -.0047 | -.0075 | -.0133 |
| 19.40 | .00  | .9412  | .2796 | .0675  | -.0044 | -.0042 | -.0020 |
| 1.52  | .00  | .2636  | .0346 | -.0205 | .0007  | -.0005 | -.0001 |

RUN 34

| ALPHA | BETA | CL     | CD    | CM     | CPM    | CYM    | CSF    |
|-------|------|--------|-------|--------|--------|--------|--------|
| 1.51  | .00  | .2615  | .0329 | -.0208 | .0007  | -.0003 | -.0008 |
| -5.24 | .00  | -.0167 | .0402 | -.0430 | .0011  | .0001  | -.0008 |
| -3.00 | .00  | .0716  | .0323 | -.0317 | .0009  | -.0001 | -.0008 |
| -.79  | .00  | .1638  | .0297 | -.0246 | .0009  | -.0002 | -.0006 |
| 1.51  | .00  | .2587  | .0329 | -.0209 | .0007  | -.0003 | -.0008 |
| 3.76  | .00  | .2457  | .0408 | -.0177 | .0004  | -.0005 | .0001  |
| 5.96  | .00  | .4235  | .0536 | -.0119 | -.0001 | -.0006 | .0004  |
| 8.18  | .00  | .5091  | .0743 | -.0046 | -.0003 | -.0004 | -.0006 |
| 10.39 | -.01 | .5789  | .0958 | .0090  | .0003  | -.0011 | -.0026 |
| 12.65 | -.03 | .6676  | .1280 | .0213  | .0019  | -.0036 | -.0117 |
| 14.90 | -.04 | .7589  | .1735 | .0392  | .0017  | -.0052 | -.0189 |
| 17.12 | -.04 | .8535  | .2278 | .0559  | -.0056 | -.0073 | -.0151 |
| 19.37 | .01  | .9287  | .2860 | .0772  | -.0076 | -.0057 | .0042  |
| 1.51  | .00  | .2614  | .0328 | -.0209 | .0007  | -.0003 | -.0007 |

RUN 35

| ALPHA | BETA | CL     | CD    | CM     | CPM    | CYM   | CSF    |
|-------|------|--------|-------|--------|--------|-------|--------|
| 1.09  | 5.03 | .1052  | .0191 | .0128  | .0003  | .0059 | .0026  |
| -5.67 | 5.04 | -.1797 | .0464 | -.0119 | -.0035 | .0093 | .0340  |
| -3.46 | 5.03 | -.0881 | .0315 | -.0004 | -.0019 | .0083 | .0222  |
| -1.22 | 5.03 | .0052  | .0226 | .0088  | -.0013 | .0073 | .0121  |
| 1.07  | 5.03 | .1043  | .0190 | .0129  | .0003  | .0059 | .0028  |
| 3.34  | 5.02 | .1919  | .0217 | .0178  | .0036  | .0055 | -.0066 |
| 5.54  | 5.02 | .2770  | .0302 | .0244  | .0069  | .0055 | -.0144 |
| 7.75  | 5.03 | .3572  | .0446 | .0343  | .0069  | .0045 | -.0178 |
| 9.99  | 5.03 | .4353  | .0641 | .0481  | .0069  | .0039 | -.0261 |
| 12.25 | 5.02 | .5181  | .0893 | .0630  | .0057  | .0051 | -.0381 |
| 14.44 | 5.00 | .6084  | .1200 | .0768  | .0096  | .0038 | -.0556 |
| 16.73 | 5.00 | .6970  | .1637 | .0942  | .0085  | .0059 | -.0616 |
| 19.01 | 5.04 | .8042  | .2301 | .1125  | .0044  | .0097 | -.0537 |
| 1.08  | 5.03 | .1051  | .0189 | .0131  | .0004  | .0059 | .0023  |

RUN 36

| ALPHA | BETA  | CL     | CD    | CM     | CPM    | CYM   | CSF    |
|-------|-------|--------|-------|--------|--------|-------|--------|
| 1.11  | 10.06 | .1139  | .0246 | .0127  | .0011  | .0140 | .0070  |
| -5.61 | 10.06 | -.1580 | .0520 | -.0162 | -.0077 | .0194 | .0690  |
| -3.40 | 10.06 | -.0658 | .0365 | -.0049 | -.0042 | .0180 | .0461  |
| -1.16 | 10.07 | .0280  | .0272 | .0034  | -.0021 | .0159 | .0248  |
| 1.11  | 10.06 | .1133  | .0247 | .0126  | .0010  | .0139 | .0071  |
| 3.37  | 10.06 | .1959  | .0271 | .0219  | .0059  | .0132 | -.0105 |
| 5.62  | 10.05 | .2913  | .0357 | .0309  | .0110  | .0131 | -.0273 |
| 7.83  | 10.06 | .3772  | .0504 | .0430  | .0134  | .0132 | -.0416 |
| 10.05 | 10.05 | .4597  | .0726 | .0593  | .0133  | .0116 | -.0594 |
| 12.30 | 10.03 | .5446  | .1013 | .0782  | .0136  | .0137 | -.0822 |
| 14.53 | 10.02 | .6358  | .1383 | .0945  | .0115  | .0181 | -.0984 |
| 16.81 | 10.04 | .7455  | .1874 | .1070  | .0140  | .0243 | -.1169 |
| 19.13 | 10.04 | .8484  | .2489 | .1323  | .0099  | .0266 | -.1251 |
| 1.11  | 10.06 | .1154  | .0247 | .0129  | .0011  | .0141 | .0066  |

RUN 37

| ALPHA | BETA | CL     | CD    | CM     | CPM    | CYM    | CSF    |
|-------|------|--------|-------|--------|--------|--------|--------|
| 1.13  | .00  | .1237  | .0162 | .0204  | .0011  | -.0002 | -.0004 |
| -5.68 | .00  | -.1819 | .0386 | -.0022 | .0009  | .0001  | -.0002 |
| -3.42 | .00  | -.0830 | .0248 | .0094  | .0012  | .0000  | -.0002 |
| -1.15 | .00  | .0204  | .0176 | .0171  | .0011  | .0000  | -.0004 |
| 1.13  | .00  | .1230  | .0164 | .0205  | .0010  | -.0002 | -.0002 |
| 3.42  | .00  | .2134  | .0209 | .0259  | .0010  | -.0003 | -.0002 |
| 5.61  | .00  | .2958  | .0316 | .0257  | .0007  | -.0003 | -.0006 |
| 7.82  | .00  | .3742  | .0452 | .0504  | .0001  | -.0004 | -.0011 |
| 10.14 | .00  | .4840  | .0798 | .0751  | .0005  | -.0014 | -.0012 |
| 12.45 | -.01 | .6022  | .1269 | .1028  | .0012  | -.0037 | -.0064 |
| 14.77 | -.02 | .7190  | .1836 | .1367  | .0018  | -.0068 | -.0120 |
| 17.17 | -.02 | .8559  | .2632 | .1650  | -.0012 | -.0068 | -.0143 |
| 19.70 | -.02 | 1.0474 | .3740 | .1909  | -.0058 | -.0065 | -.0078 |
| 1.14  | .00  | .1244  | .0158 | .0208  | .0011  | -.0002 | .0005  |

TABLE AII. - CONTINUED

RUN 38

| ALPHA | BETA | CL     | CD    | CM     | CRM    | CYM    | CSF    |
|-------|------|--------|-------|--------|--------|--------|--------|
| 1.14  | .00  | .1256  | .0167 | .0207  | .0009  | -.0003 | -.0001 |
| -5.67 | .00  | -.1797 | .0388 | -.0033 | .0010  | -.0002 | .0002  |
| -3.42 | .00  | -.0628 | .0255 | .0089  | .0012  | -.0002 | .0000  |
| -1.19 | .00  | .0197  | .0183 | .0166  | .0010  | -.0002 | .0000  |
| 1.14  | .00  | .1241  | .0170 | .0206  | .0009  | -.0003 | .0000  |
| 3.40  | .00  | .2151  | .0214 | .0254  | .0009  | -.0003 | -.0002 |
| 5.62  | .00  | .2962  | .0317 | .0345  | .0005  | -.0004 | -.0006 |
| 7.81  | .00  | .3817  | .0451 | .0467  | .0002  | -.0004 | -.0011 |
| 10.17 | .00  | .4941  | .0777 | .0696  | .0002  | -.0014 | -.0010 |
| 12.51 | -.01 | .6196  | .1230 | .0940  | .0013  | -.0040 | -.0065 |
| 14.83 | -.03 | .7467  | .1801 | .1227  | .0013  | -.0067 | -.0118 |
| 17.26 | -.03 | .8635  | .2581 | .1521  | -.0020 | -.0088 | -.0145 |
| 19.67 | -.03 | 1.0406 | .3519 | .1806  | -.0046 | -.0063 | -.0111 |
| 1.14  | .00  | .1262  | .0168 | .0207  | .0009  | -.0003 | .0000  |

RUN 39

| ALPHA | BETA | CL     | CD    | CM     | CRM    | CYM    | CSF    |
|-------|------|--------|-------|--------|--------|--------|--------|
| 1.56  | .00  | .2812  | .0342 | -.0126 | .0007  | -.0005 | .0004  |
| -5.24 | .00  | -.0123 | .0359 | -.0351 | .0008  | -.0002 | .0003  |
| -2.98 | .00  | .0828  | .0294 | -.0229 | .0007  | -.0003 | .0004  |
| -.72  | .00  | .1833  | .0288 | -.0167 | .0008  | -.0003 | .0003  |
| 1.55  | .00  | .2798  | .0341 | -.0127 | .0007  | -.0005 | .0005  |
| 3.82  | .00  | .3667  | .0458 | -.0060 | .0004  | -.0004 | -.0001 |
| 6.04  | .00  | .4531  | .0603 | .0034  | .0000  | -.0003 | -.0004 |
| 8.29  | .00  | .5470  | .0799 | .0119  | .0000  | -.0005 | -.0006 |
| 10.63 | .00  | .6715  | .1250 | .0361  | .0002  | -.0017 | -.0011 |
| 13.00 | -.02 | .7773  | .1803 | .0627  | .0008  | -.0042 | -.0069 |
| 15.32 | -.02 | .9182  | .2454 | .0944  | -.0002 | -.0070 | -.0107 |
| 17.67 | -.03 | 1.0390 | .3232 | .1314  | -.0040 | -.0088 | -.0119 |
| 20.01 | -.03 | 1.1580 | .4157 | .1666  | -.0050 | -.0062 | -.0114 |
| 1.56  | .00  | .2828  | .0342 | -.0122 | .0007  | -.0004 | .0003  |

RUN 40

| ALPHA | BETA | CL     | CD    | CM     | CRM    | CYM    | CSF    |
|-------|------|--------|-------|--------|--------|--------|--------|
| 1.55  | .00  | .2781  | .0329 | -.0126 | .0010  | -.0003 | -.0002 |
| -5.21 | .00  | -.0124 | .0350 | -.0348 | .0008  | .0000  | -.0002 |
| -2.97 | .00  | .0816  | .0284 | -.0229 | .0009  | -.0001 | -.0003 |
| -.72  | .00  | .1846  | .0279 | -.0168 | .0010  | -.0002 | .0002  |
| 1.54  | .00  | .2783  | .0331 | -.0125 | .0010  | -.0004 | -.0001 |
| 3.80  | .00  | .3633  | .0448 | -.0057 | .0007  | -.0005 | -.0001 |
| 6.02  | .00  | .4459  | .0591 | .0055  | .0002  | -.0003 | -.0008 |
| 8.26  | .00  | .5375  | .0784 | .0144  | .0001  | -.0004 | -.0016 |
| 10.62 | .00  | .6636  | .1286 | .0411  | .0001  | -.0016 | -.0011 |
| 13.00 | -.02 | .7875  | .1867 | .0700  | .0010  | -.0042 | -.0076 |
| 15.30 | -.03 | .9118  | .2553 | .1038  | .0015  | -.0070 | -.0131 |
| 17.69 | -.03 | 1.0461 | .3414 | .1407  | -.0026 | -.0088 | -.0121 |
| 20.17 | -.02 | 1.2151 | .4577 | .1718  | -.0055 | -.0059 | -.0056 |
| 1.57  | .00  | .2817  | .0330 | -.0121 | .0010  | -.0003 | -.0001 |

RUN 41

| ALPHA | BETA | CL     | CD    | CM     | CRM    | CYM    | CSF    |
|-------|------|--------|-------|--------|--------|--------|--------|
| 1.15  | 5.02 | .1270  | .0175 | .0200  | .0009  | .0041  | .0000  |
| -5.65 | 5.03 | -.1679 | .0392 | -.0066 | -.0040 | .0064  | .0297  |
| -3.40 | 5.03 | -.0761 | .0258 | .0068  | -.0037 | .0054  | .0187  |
| -1.16 | 5.02 | .0244  | .0185 | .0148  | -.0017 | .0047  | .0088  |
| 1.14  | 5.02 | .1250  | .0174 | .0198  | .0009  | .0041  | .0000  |
| 3.38  | 5.02 | .2135  | .0228 | .0277  | .0048  | .0042  | -.0077 |
| 5.61  | 5.02 | .2960  | .0335 | .0419  | .0076  | .0040  | -.0154 |
| 7.84  | 5.00 | .3918  | .0529 | .0596  | .0087  | .0054  | -.0327 |
| 10.10 | 4.97 | .4887  | .0783 | .0795  | .0100  | .0059  | -.0565 |
| 12.50 | 4.94 | .6121  | .1259 | .1098  | .0134  | .0052  | -.0796 |
| 14.82 | 4.94 | .7440  | .1897 | .1418  | .0128  | -.0029 | -.0906 |
| 17.20 | 4.94 | .8777  | .2670 | .1730  | .0083  | -.0059 | -.1061 |
| 19.72 | 4.96 | 1.0618 | .3772 | .1961  | .0050  | -.0054 | -.1123 |
| 1.13  | 5.02 | .1257  | .0175 | .0201  | .0012  | .0040  | -.0005 |

RUN 42

| ALPHA | BETA  | CL     | CD    | CM     | CRM    | CYM    | CSF    |
|-------|-------|--------|-------|--------|--------|--------|--------|
| 1.15  | 10.05 | .1320  | .0217 | .0262  | .001P  | .0109  | -.0005 |
| -5.60 | 10.07 | -.1457 | .0424 | -.0114 | -.0083 | .0145  | .0570  |
| -3.35 | 10.06 | -.0558 | .0290 | .0027  | -.0068 | .0130  | .0362  |
| -1.12 | 10.05 | .0405  | .0222 | .0129  | -.0038 | .0114  | .0171  |
| 1.15  | 10.05 | .1322  | .0217 | .0262  | .0016  | .0112  | -.0005 |
| 3.44  | 10.04 | .2302  | .0286 | .0415  | .0042  | .0112  | -.021P |
| 5.70  | 10.03 | .330P  | .0426 | .0603  | .012P  | .0115  | -.0461 |
| 7.94  | 10.00 | .4271  | .0632 | .0793  | .0154  | .0112  | -.0734 |
| 10.22 | 9.96  | .5277  | .0900 | .1054  | .0177  | .0095  | -.1112 |
| 12.56 | 9.91  | .6431  | .1280 | .1292  | .0230  | .0078  | -.1527 |
| 14.90 | 9.92  | .7676  | .191P | .1583  | .0175  | .0017  | -.1708 |
| 17.29 | 9.95  | .9127  | .2764 | .1868  | .0112  | .0029  | -.1836 |
| 19.80 | 9.97  | 1.0829 | .3779 | .2110  | .0052  | -.0015 | -.2114 |
| 1.17  | 10.05 | .1341  | .0216 | .0270  | .0019  | .0110  | -.0008 |

RUN 43

| ALPHA | BETA | CL     | CD    | CM     | CRM    | CYM    | CSF    |
|-------|------|--------|-------|--------|--------|--------|--------|
| 1.04  | .00  | .0861  | .0283 | .0208  | .0007  | .0002  | -.0005 |
| -5.79 | .00  | -.2183 | .0599 | -.0126 | .0009  | .0001  | -.0002 |
| -3.54 | .00  | -.1222 | .0433 | .0013  | .0010  | .0000  | -.0007 |
| -1.2P | .00  | -.0193 | .0325 | .0121  | .0007  | .0000  | -.0006 |
| 1.03  | .00  | .0845  | .0283 | .0208  | .0008  | .0002  | -.0007 |
| 3.33  | .00  | .1851  | .0312 | .0288  | .0008  | .0000  | -.0003 |
| 5.57  | .00  | .2812  | .0408 | .0371  | .0003  | -.0002 | -.0003 |
| 7.79  | .00  | .3711  | .0555 | .0473  | .0002  | -.0003 | -.0007 |
| 10.06 | -.01 | .4580  | .0752 | .0635  | .0002  | -.0008 | -.0029 |
| 12.2P | -.02 | .5361  | .0965 | .0808  | .0010  | -.0030 | -.0094 |
| 14.44 | -.04 | .6065  | .1202 | .1023  | .0010  | -.0053 | -.0153 |
| 16.83 | -.02 | .7440  | .1872 | .1380  | -.0014 | -.0086 | -.0096 |
| 19.28 | .00  | .9039  | .2745 | .1653  | -.0077 | -.0062 | -.0003 |
| 1.03  | .00  | .0851  | .0279 | .0211  | .0008  | .0001  | -.0003 |

RUN 44

| ALPHA | BETA | CL     | CD    | CM     | CRM    | CYM    | CSF    |
|-------|------|--------|-------|--------|--------|--------|--------|
| 1.03  | .00  | .084P  | .0279 | .0210  | .0008  | -.0001 | -.0003 |
| -5.79 | .00  | -.2175 | .0604 | -.0135 | .0007  | -.0001 | -.0001 |
| -3.53 | .00  | -.1222 | .043P | .0011  | .0009  | -.0002 | -.0003 |
| -1.29 | .00  | -.0231 | .0320 | .0132  | .0009  | -.0001 | -.0002 |
| 1.03  | .00  | .0843  | .0282 | .0209  | .0008  | -.0001 | -.0002 |
| 3.32  | .00  | .187P  | .0305 | .0270  | .0008  | -.0001 | -.0003 |
| 5.60  | .00  | .2874  | .0393 | .0341  | .0000  | -.0002 | -.0003 |
| 7.83  | .00  | .3823  | .0540 | .042P  | -.0003 | -.0004 | -.0008 |
| 10.0P | -.01 | .4705  | .0734 | .0568  | -.0002 | -.0012 | -.002P |
| 12.3P | -.02 | .5552  | .0964 | .0719  | .0006  | -.0032 | -.0081 |
| 14.54 | -.03 | .6362  | .1221 | .0915  | .0002  | -.0052 | -.0143 |
| 16.86 | -.02 | .7550  | .1822 | .1334  | -.0018 | -.0079 | -.0052 |
| 19.31 | -.01 | .9155  | .266P | .1592  | -.0056 | -.0054 | -.0030 |
| 1.04  | .00  | .08P1  | .02P0 | .0213  | .0007  | -.0002 | -.0002 |

RUN 45

| ALPHA | BETA | CL     | CD    | CM     | CRM    | CYM    | CSF    |
|-------|------|--------|-------|--------|--------|--------|--------|
| 1.49  | .00  | .2541  | .0437 | -.0125 | .0006  | -.0002 | -.0001 |
| -5.28 | .00  | -.03P6 | .0541 | -.0450 | .0006  | -.0002 | -.0001 |
| -3.05 | .00  | .0541  | .0452 | -.0305 | .0005  | -.0002 | .0001  |
| -.84  | .00  | .1499  | .0413 | -.0200 | .0005  | -.0002 | .0001  |
| 1.5P  | .00  | .2534  | .0437 | -.0124 | .0005  | -.0002 | -.0002 |
| 3.76  | .00  | .3529  | .0532 | -.0065 | .0001  | -.0003 | .0000  |
| 6.05  | .00  | .4537  | .0694 | -.0003 | -.0005 | -.0003 | .0000  |
| 8.27  | .00  | .5430  | .0896 | .0123  | -.0006 | -.0005 | -.0007 |
| 10.52 | -.01 | .6311  | .1143 | .0256  | -.0005 | -.0011 | -.0027 |
| 12.7P | -.02 | .7189  | .1419 | .0400  | .0004  | -.0033 | -.0051 |
| 14.9P | -.03 | .794P  | .172P | .0644  | -.0009 | -.0034 | -.0127 |
| 17.24 | -.02 | .8276  | .24P6 | .10P2  | -.0029 | -.0063 | -.0085 |
| 19.6P | -.01 | 1.0490 | .32P4 | .1457  | -.0052 | -.0040 | -.0047 |
| 1.50  | .00  | .2572  | .0437 | -.0124 | .0005  | -.0003 | -.0004 |



FLA 46

| ALPHA | BETA | CL     | CD    | CM     | CRM    | CYM    | CSF    |
|-------|------|--------|-------|--------|--------|--------|--------|
| 1.42  | .00  | .2490  | .0436 | -.0119 | .0007  | .0001  | -.0012 |
| -5.29 | .00  | -.0409 | .0536 | -.0450 | .0009  | .0000  | -.0009 |
| -3.05 | .00  | .0546  | .0444 | -.0316 | .0008  | .0001  | -.0010 |
| -.85  | .00  | .1509  | .0409 | -.0208 | .0007  | .0001  | -.0011 |
| 1.47  | .00  | .2482  | .0437 | -.0121 | .0007  | .0001  | -.0012 |
| 3.77  | .00  | .3487  | .0537 | -.0048 | .0005  | .0000  | -.0007 |
| 6.02  | .00  | .4473  | .0703 | .0020  | .0001  | -.0002 | -.0006 |
| 8.25  | .00  | .5342  | .0905 | .0155  | .0000  | -.0003 | -.0013 |
| 10.47 | -.01 | .6152  | .1148 | .0304  | -.0003 | -.0008 | -.0036 |
| 12.73 | -.02 | .7000  | .1419 | .0479  | .0002  | -.0031 | -.0110 |
| 14.92 | -.04 | .7777  | .1741 | .0738  | .0006  | -.0007 | -.0170 |
| 17.32 | -.02 | .9296  | .2564 | .1064  | -.0033 | -.0081 | -.0073 |
| 19.73 | .00  | 1.0628 | .3463 | .1463  | -.0085 | -.0056 | .0017  |
| 1.50  | .00  | .2540  | .0437 | -.0117 | .0007  | .0001  | -.0012 |

FLA 47

| ALPHA | BETA | CL     | CD    | CM     | CRM    | CYM   | CSF    |
|-------|------|--------|-------|--------|--------|-------|--------|
| 1.06  | 5.05 | .0875  | .0316 | .0197  | -.0025 | .0044 | .0131  |
| -5.78 | 5.05 | -.2146 | .0632 | -.0146 | -.0067 | .0074 | .0432  |
| -3.52 | 5.05 | -.1182 | .0463 | -.0007 | -.0050 | .0065 | .0323  |
| -1.25 | 5.05 | -.0159 | .0352 | .0103  | -.0036 | .0054 | .0221  |
| 1.05  | 5.05 | .0856  | .0317 | .0194  | -.0024 | .0043 | .0133  |
| 3.34  | 5.05 | .1862  | .0340 | .0275  | -.0003 | .0035 | .0049  |
| 5.61  | 5.05 | .2827  | .0440 | .0392  | .0010  | .0030 | -.0017 |
| 7.80  | 5.06 | .3681  | .0567 | .0520  | .0038  | .0032 | -.0068 |
| 10.04 | 5.06 | .4514  | .0757 | .0697  | .0077  | .0015 | -.0123 |
| 12.34 | 5.03 | .5510  | .1069 | .0961  | .0091  | .0008 | -.0374 |
| 14.59 | 4.98 | .6551  | .1452 | .1206  | .0094  | .0016 | -.0650 |
| 16.88 | 4.54 | .7605  | .1907 | .1432  | .0073  | .0024 | -.0917 |
| 19.32 | 4.97 | .9141  | .2766 | .1710  | .0039  | .0047 | -.0963 |
| 1.04  | 5.05 | .0873  | .0316 | .0199  | -.0024 | .0043 | .0128  |

FLA 48

| ALPHA | BETA  | CL     | CD    | CM     | CRM    | CYM   | CSF    |
|-------|-------|--------|-------|--------|--------|-------|--------|
| 1.05  | 10.10 | .0905  | .0378 | .0207  | -.0065 | .0109 | .0286  |
| -5.73 | 10.11 | -.1996 | .0697 | -.0184 | -.0142 | .0159 | .0864  |
| -3.48 | 10.10 | -.1014 | .0519 | -.0046 | -.0104 | .0145 | .0641  |
| -1.23 | 10.10 | -.0052 | .0418 | .0086  | -.0082 | .0126 | .0454  |
| 1.05  | 10.10 | .0894  | .0380 | .0207  | -.0066 | .0110 | .0292  |
| 3.33  | 10.10 | .1857  | .0404 | .0333  | -.0018 | .0102 | .0130  |
| 5.59  | 10.11 | .2786  | .0494 | .0527  | .0018  | .0094 | -.0014 |
| 7.84  | 10.10 | .3775  | .0674 | .0754  | .0044  | .0097 | -.0239 |
| 10.12 | 10.07 | .4855  | .0931 | .0960  | .0110  | .0097 | -.0567 |
| 12.48 | 10.04 | .6017  | .1291 | .1227  | .0138  | .0093 | -.0902 |
| 14.76 | 10.01 | .7108  | .1718 | .1527  | .0115  | .0077 | -.1216 |
| 17.14 | 9.97  | .8502  | .2322 | .1734  | .0128  | .0073 | -.1664 |
| 1.06  | 10.10 | .0918  | .0378 | .0209  | -.0065 | .0108 | .0286  |

FLA 49

| ALPHA | BETA | CL     | CD    | CM     | CRM    | CYM    | CSF    |
|-------|------|--------|-------|--------|--------|--------|--------|
| 1.17  | .00  | .1301  | .0170 | .0080  | .0005  | -.0002 | -.0007 |
| -5.59 | .00  | -.1491 | .0376 | -.0267 | .0006  | -.0004 | -.0006 |
| -3.34 | .00  | -.0540 | .0241 | -.0135 | .0008  | -.0004 | -.0008 |
| -1.10 | .00  | .0403  | .0178 | -.0020 | .0006  | -.0003 | -.0006 |
| 1.17  | .00  | .1294  | .0169 | .0080  | .0005  | -.0002 | -.0006 |
| 3.39  | .00  | .2122  | .0203 | .0156  | .0002  | -.0002 | -.0006 |
| 5.61  | .00  | .2918  | .0279 | .0223  | .0000  | -.0003 | -.0009 |
| 7.82  | .00  | .3758  | .0401 | .0284  | -.0003 | -.0005 | -.0015 |
| 10.05 | -.01 | .4632  | .0605 | .0351  | -.0001 | -.0014 | -.0031 |
| 12.30 | -.01 | .5401  | .0869 | .0487  | -.0011 | -.0034 | -.0062 |
| 14.53 | -.02 | .6325  | .1280 | .0629  | -.0013 | -.0053 | -.0100 |
| 16.80 | -.01 | .7360  | .1805 | .0769  | -.0073 | -.0067 | -.0052 |
| 19.17 | -.01 | .8471  | .2470 | .0981  | -.0073 | -.0081 | -.0030 |
| 1.16  | .00  | .1308  | .0167 | .0083  | .0004  | -.0002 | -.0004 |

TABLE AII. - CONTINUED

RUK 50

| ALPHA | BETA | CL     | CD    | CM     | CRM    | CYM    | CSF    |
|-------|------|--------|-------|--------|--------|--------|--------|
| 1.17  | .00  | .1302  | .0169 | .0081  | .0005  | -.0002 | -.0007 |
| -5.5P | .00  | -.1486 | .0373 | -.0267 | .0006  | -.0004 | -.000P |
| -3.32 | .00  | -.0534 | .0240 | -.0133 | .0009  | -.0004 | -.0009 |
| -1.11 | .00  | .0405  | .0177 | -.0021 | .0006  | -.0003 | -.0007 |
| 1.1E  | .00  | .1292  | .0169 | .0079  | .0005  | -.0002 | -.0007 |
| 3.41  | .00  | .2124  | .0204 | .0156  | .0003  | -.0002 | -.0007 |
| 5.62  | .00  | .2919  | .0279 | .0221  | .0001  | -.0003 | -.0011 |
| 7.81  | .00  | .374P  | .0400 | .0286  | -.0004 | -.0005 | -.0014 |
| 10.0P | -.01 | .4635  | .0607 | .0350  | -.0001 | -.0015 | -.0031 |
| 12.30 | -.02 | .53P4  | .0P6P | .0487  | -.0007 | -.0032 | -.0067 |
| 14.55 | -.02 | .6315  | .12P2 | .0627  | -.0016 | -.0056 | -.0096 |
| 16.82 | -.01 | .7355  | .1P09 | .0766  | -.0075 | -.007P | -.0046 |
| 19.13 | .00  | .P403  | .2436 | .0976  | -.0077 | -.0084 | -.0015 |
| 1.17  | .00  | .1315  | .016P | .00P3  | .0005  | -.0002 | -.0004 |

RUK 51

| ALPHA | BETA | CL     | CD    | CM     | CRM    | CYM    | CSF    |
|-------|------|--------|-------|--------|--------|--------|--------|
| 1.17  | .00  | .1314  | .0176 | .0083  | .0004  | -.0004 | -.0004 |
| -5.5P | .00  | -.1489 | .03P0 | -.0266 | .0008  | -.0005 | -.000P |
| -3.33 | .00  | -.0535 | .0245 | -.0134 | .0009  | -.0005 | -.0010 |
| -1.10 | .00  | .0399  | .01P4 | -.0019 | .0007  | -.0004 | -.0006 |
| 1.14  | .00  | .12P7  | .01P1 | .0080  | .0005  | -.0004 | -.0005 |
| 3.39  | .00  | .2122  | .0214 | .0159  | .0002  | -.0004 | -.0005 |
| 5.61  | .00  | .2917  | .0291 | .0226  | .0000  | -.0005 | -.0010 |
| 7.80  | .00  | .3760  | .0415 | .0293  | -.0004 | -.0006 | -.0019 |
| 10.0P | -.01 | .4670  | .0622 | .0338  | -.0002 | -.0015 | -.0032 |
| 12.32 | -.02 | .5456  | .0P7P | .0447  | -.0004 | -.0033 | -.007P |
| 14.49 | -.02 | .615P  | .1209 | .0654  | -.0025 | -.0051 | -.0106 |
| 16.69 | -.02 | .6P66  | .1652 | .0904  | -.0056 | -.007P | -.0073 |
| 1P.98 | .00  | .7P8P  | .223P | .1102  | -.0067 | -.0085 | -.0019 |
| 1.1P  | .00  | .1315  | .0177 | .0083  | .0004  | -.0003 | -.0005 |

RUK 52

| ALPHA | BETA | CL     | CD    | CM     | CRM    | CYM    | CSF    |
|-------|------|--------|-------|--------|--------|--------|--------|
| 1.1E  | .00  | .132P  | .0177 | .0082  | .0004  | -.0004 | -.0004 |
| -5.59 | .00  | -.149P | .03P1 | -.0267 | .0007  | -.0005 | -.0006 |
| -3.33 | .00  | -.0540 | .024P | -.0137 | .0009  | -.0005 | -.0007 |
| -1.13 | .00  | .0400  | .01P5 | -.0023 | .0007  | -.0004 | -.0004 |
| 1.1P  | .00  | .1301  | .017P | .0079  | .0005  | -.0003 | -.0003 |
| 3.40  | .00  | .2141  | .0215 | .0157  | .0003  | -.0003 | -.0003 |
| 5.64  | .00  | .2964  | .0296 | .0222  | .0000  | -.0005 | -.0007 |
| 7.86  | .00  | .3P61  | .0434 | .0255  | -.0002 | -.0007 | -.0014 |
| 10.06 | -.01 | .46P0  | .0627 | .0346  | -.0006 | -.0014 | -.0026 |
| 12.32 | -.02 | .5495  | .0P89 | .0448  | -.0005 | -.0030 | -.0074 |
| 14.4P | -.02 | .6152  | .1246 | .0656  | -.0023 | -.0059 | -.00P6 |
| 16.73 | -.01 | .7035  | .170P | .0P41  | -.0064 | -.007P | -.0056 |

RUK 53

| ALPHA | BETA | CL     | CD    | CM     | CRM    | CYM    | CSF    |
|-------|------|--------|-------|--------|--------|--------|--------|
| 1.25  | .00  | .1302  | .0176 | .0078  | .0003  | -.000P | -.0006 |
| -5.75 | .00  | -.1652 | .0401 | -.0297 | .0003  | -.0006 | -.0000 |
| -3.40 | .00  | -.063P | .0256 | -.014P | .0005  | -.0006 | -.0003 |
| -1.10 | .00  | .0335  | .01P7 | -.0029 | .0005  | -.0007 | -.0004 |
| 1.24  | .00  | .1267  | .017P | .0074  | .0003  | -.0007 | -.0006 |
| 3.56  | .00  | .214P  | .021P | .015P  | .0000  | -.0007 | -.0003 |
| 5.82  | .00  | .2992  | .0300 | .0231  | -.0004 | -.0007 | -.0004 |
| 8.11  | .00  | .386P  | .0435 | .0296  | -.0007 | -.0007 | -.0011 |
| 10.44 | -.01 | .4832  | .0661 | .0361  | -.0006 | -.0015 | -.0033 |
| 12.74 | -.04 | .565P  | .0942 | .0502  | -.0005 | -.0031 | -.0100 |
| 14.95 | -.06 | .6346  | .1342 | .0756  | -.0037 | -.0084 | -.0163 |
| 17.36 | -.0P | .7456  | .1936 | .0903  | -.003P | -.0102 | -.0207 |

TABLE AII. - CONCLUDED

RUN 54

| ALPHA | BETA | CL     | CD    | CM     | CPM    | CYP    | CSF    |
|-------|------|--------|-------|--------|--------|--------|--------|
| 1.38  | .00  | .2056  | .0238 | -.0068 | .0001  | -.0005 | -.0004 |
| -5.35 | .00  | -.0582 | .0342 | -.0435 | .0007  | -.0006 | -.0005 |
| -3.06 | .00  | .0358  | .0249 | -.0298 | .0006  | -.0006 | -.0005 |
| -.88  | .00  | .1216  | .0220 | -.0176 | .0002  | -.0004 | -.0003 |
| 1.36  | .00  | .2042  | .0239 | -.0070 | .0002  | -.0004 | -.0005 |
| 3.61  | .00  | .2854  | .0300 | .0011  | -.0002 | -.0005 | -.0002 |
| 5.81  | .00  | .3647  | .0400 | .0080  | -.0004 | -.0006 | -.0006 |
| 8.02  | .00  | .4519  | .0566 | .0135  | -.0005 | -.0007 | -.0014 |
| 10.28 | -.01 | .5397  | .0802 | .0198  | -.0008 | -.0013 | -.0025 |
| 12.51 | -.02 | .6171  | .1087 | .0320  | -.0006 | -.0034 | -.0072 |
| 14.62 | .02  | .6694  | .1440 | .0589  | -.0036 | -.0070 | -.0079 |
| 16.88 | .02  | .7603  | .1941 | .0766  | -.0051 | -.0084 | -.0099 |

RUN 55

| ALPHA | BETA | CL    | CD    | CM     | CPM    | CYP    | CSF    |
|-------|------|-------|-------|--------|--------|--------|--------|
| 1.55  | .00  | .2740 | .0346 | -.0209 | .0000  | -.0004 | -.0002 |
| -5.15 | .00  | .0233 | .0372 | -.0580 | .0008  | -.0006 | -.0005 |
| -2.88 | .00  | .1108 | .0311 | -.0440 | .0005  | -.0005 | -.0001 |
| -.71  | .00  | .1529 | .0305 | -.0320 | .0003  | -.0004 | -.0001 |
| 1.55  | .00  | .2723 | .0345 | -.0209 | .0002  | -.0004 | .0000  |
| 3.77  | .00  | .3523 | .0430 | -.0135 | -.0001 | -.0004 | -.0003 |
| 6.01  | .00  | .4235 | .0558 | -.0068 | -.0003 | -.0006 | -.0006 |
| 8.22  | .00  | .5241 | .0758 | -.0028 | -.0006 | -.0008 | -.0010 |
| 10.46 | -.01 | .6084 | .1015 | .0052  | -.0006 | -.0014 | -.0032 |
| 12.67 | -.02 | .6771 | .1320 | .0210  | -.0016 | -.0038 | -.0074 |
| 14.82 | -.03 | .7420 | .1745 | .0445  | -.0016 | -.0067 | -.0113 |
| 17.07 | -.02 | .8298 | .2263 | .0632  | -.0049 | -.0089 | -.0090 |

RUN 56

| ALPHA | BETA | CL     | CD    | CM     | CPM    | CYP    | CSF    |
|-------|------|--------|-------|--------|--------|--------|--------|
| 1.36  | .00  | .2007  | .0212 | -.0030 | .0003  | -.0004 | .0000  |
| -5.41 | .00  | -.0828 | .0335 | -.0269 | .0008  | -.0002 | .0000  |
| -3.15 | .00  | .0109  | .0237 | -.0151 | .0004  | -.0003 | .0004  |
| -.93  | .00  | .1054  | .0197 | -.0068 | .0002  | -.0004 | .0002  |
| 1.33  | .00  | .1994  | .0210 | -.0030 | .0002  | -.0004 | .0002  |
| 3.58  | .00  | .2789  | .0273 | .0022  | .0000  | -.0005 | .0001  |
| 5.79  | .00  | .3576  | .0380 | .0087  | -.0003 | -.0005 | -.0002 |
| 8.01  | .00  | .4448  | .0543 | .0160  | -.0008 | -.0004 | -.0005 |
| 10.26 | -.01 | .5262  | .0778 | .0237  | .0002  | -.0015 | -.0024 |
| 12.53 | -.02 | .6310  | .1101 | .0356  | .0000  | -.0039 | -.0068 |
| 14.77 | -.02 | .7250  | .1536 | .0531  | -.0007 | -.0060 | -.0097 |
| 17.04 | -.03 | .8205  | .2071 | .0721  | -.0031 | -.0076 | -.0111 |

RUN 57

| ALPHA | BETA | CL     | CD    | CM     | CPM   | CYP    | CSF    |
|-------|------|--------|-------|--------|-------|--------|--------|
| .25   | .00  | .0914  | .0166 | .0168  | .0010 | .0000  | -.0008 |
| -6.53 | .00  | -.0019 | .0417 | -.0103 | .0003 | .0000  | -.0002 |
| -4.30 | .00  | -.1072 | .0273 | .0031  | .0008 | .0000  | -.0004 |
| -2.04 | .00  | -.0105 | .0191 | .0119  | .0008 | .0001  | -.0005 |
| .25   | .00  | .0513  | .0166 | .0167  | .0011 | .0000  | -.0010 |
| 2.53  | .00  | .1801  | .0192 | .0189  | .0009 | -.0001 | -.0011 |
| 4.70  | .00  | .2572  | .0263 | .0249  | .0006 | .0000  | -.0016 |
| 6.93  | .00  | .3292  | .0387 | .0331  | .0007 | .0000  | -.0019 |
| 9.21  | -.01 | .4338  | .0579 | .0419  | .0017 | -.0007 | -.0027 |
| 11.48 | -.02 | .5438  | .0888 | .0524  | .0020 | -.0019 | -.0088 |
| 13.74 | -.03 | .6458  | .1291 | .0690  | .0020 | -.0056 | -.0120 |
| 16.10 | -.03 | .7680  | .1877 | .0786  | .0002 | -.0095 | -.0135 |

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TABLE I. - GEOMETRIC CHARACTERISTICS OF MODEL

## Wing:

|   |                |
|---|----------------|
| Aspect ratio .....                              | 1.838          |
| Reference area, $m^2$ ( $ft^2$ ) .....          | 0.863 (9.293)  |
| Gross area, $m^2$ ( $ft^2$ ) .....              | 0.949 (10.210) |
| Span, m (ft) .....                              | 1.260 (4.133)  |
| Root chord, m (ft) .....                        | 1.674 (5.492)  |
| Tip chord, m (ft) .....                         | 0.161 (0.529)  |
| Reference mean aerodynamic chord, m, (ft) ..... | 0.895 (2.937)  |

## Leading-edge sweep, deg:

|  |       |
|--|-------|
| At body station 0.530 m (1.738 ft) ..... | 73.02 |
| At body station 2.027 m (6.651 ft) ..... | 60.0  |

## Vertical fin (each):

|                               |               |
|-------------------------------|---------------|
| Span, m (ft) .....            | 0.107 (0.350) |
| Root chord, m (ft) .....      | 0.326 (1.069) |
| Tip chord, m (ft) .....       | 0.048 (0.158) |
| Leading-edge sweep, deg ..... | 73.4          |
| Taper ratio .....             | 0.148         |

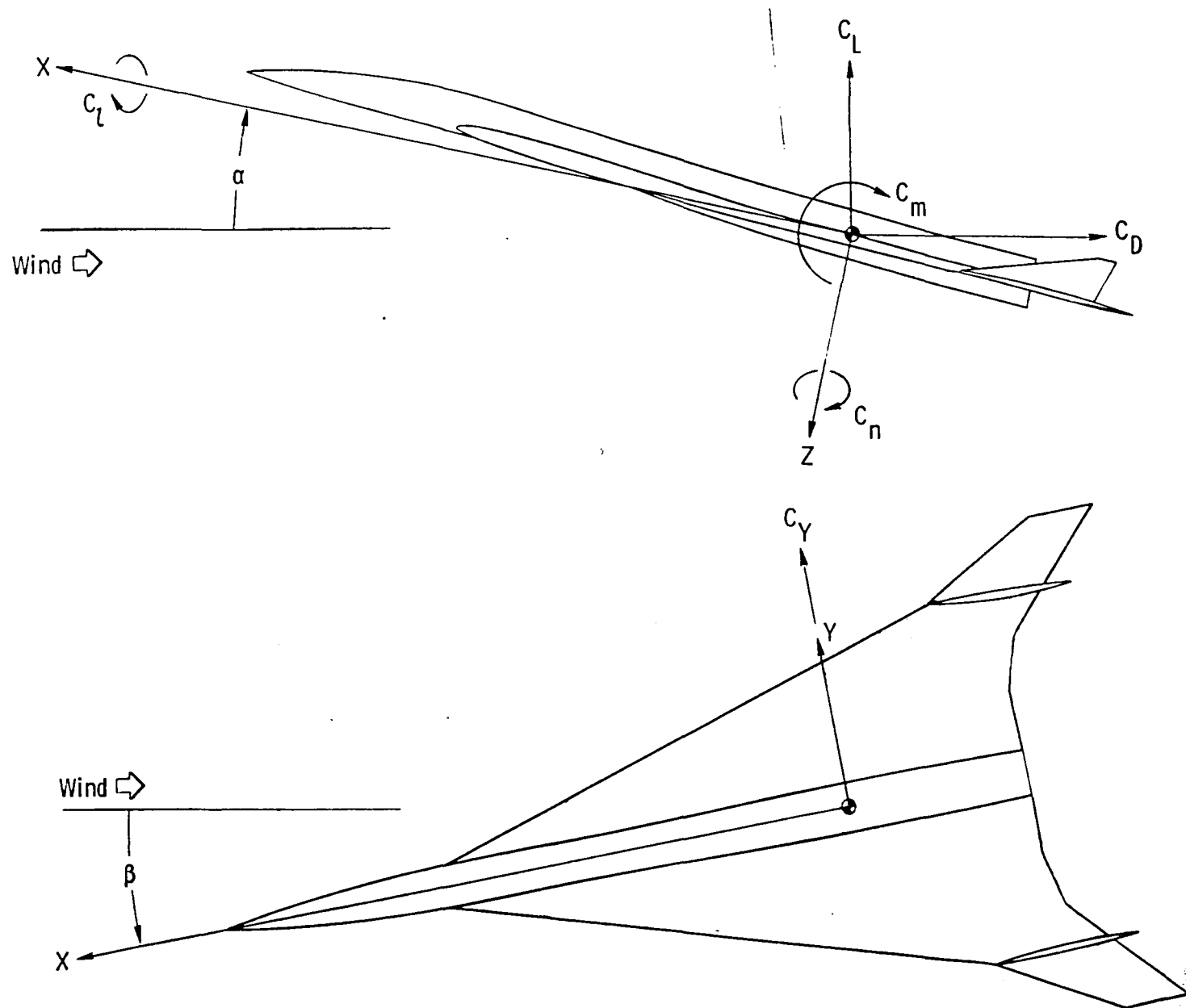


Figure 1.- System of Axes.

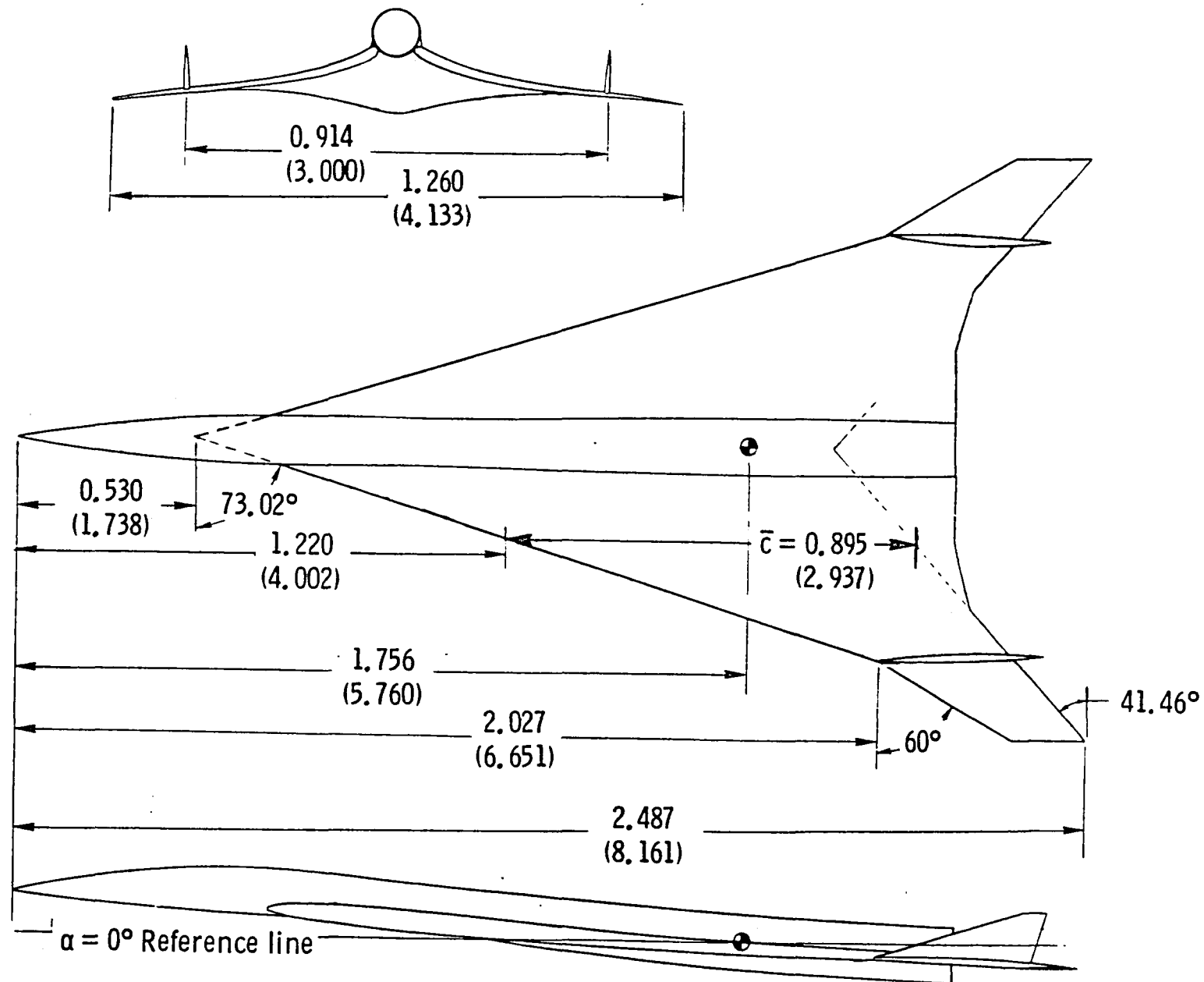


Figure 2.- Three View Sketch Of Model. Dimensions Are Given In Meters And Parenthetically In Feet.

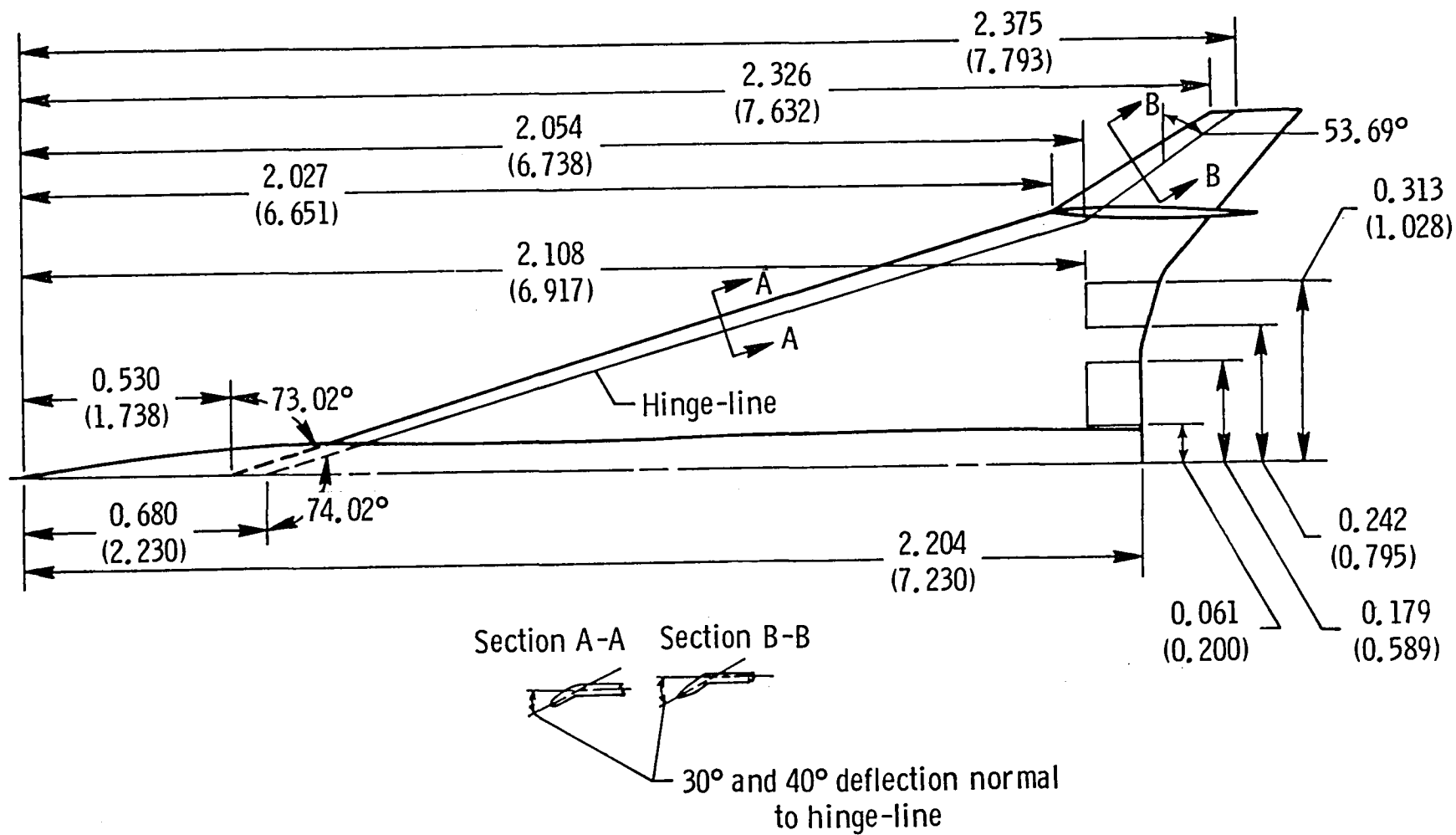


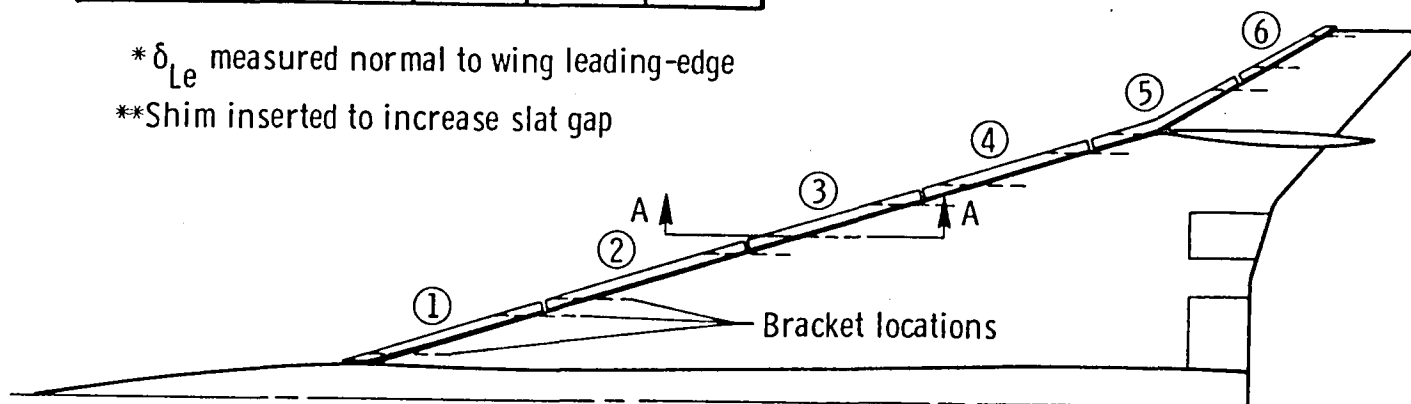
Figure 3. - Details Of Leading- and Trailing-Edge Flap Systems.  
Dimensions In Meters (ft) Unless Otherwise Noted.



| Slat element | Slat Configuration |                 | Shim thickness ** |        |
|--------------|--------------------|-----------------|-------------------|--------|
|              | I                  | II              | cm                | inches |
|              | $\delta_{Le}^*$    | $\delta_{Le}^*$ |                   |        |
| ①            | 35                 | 20              | .254              | .100   |
| ②            | 35                 | 35              | .254              | .100   |
| ③            | 35                 | 35              | .254              | .100   |
| ④            | 35                 | 35              | .127              | .050   |
| ⑤            | 30                 | 30              | .076              | .030   |
| ⑥            | 30                 | 30              | .076              | .030   |

\*  $\delta_{Le}$  measured normal to wing leading-edge

\*\* Shim inserted to increase slat gap



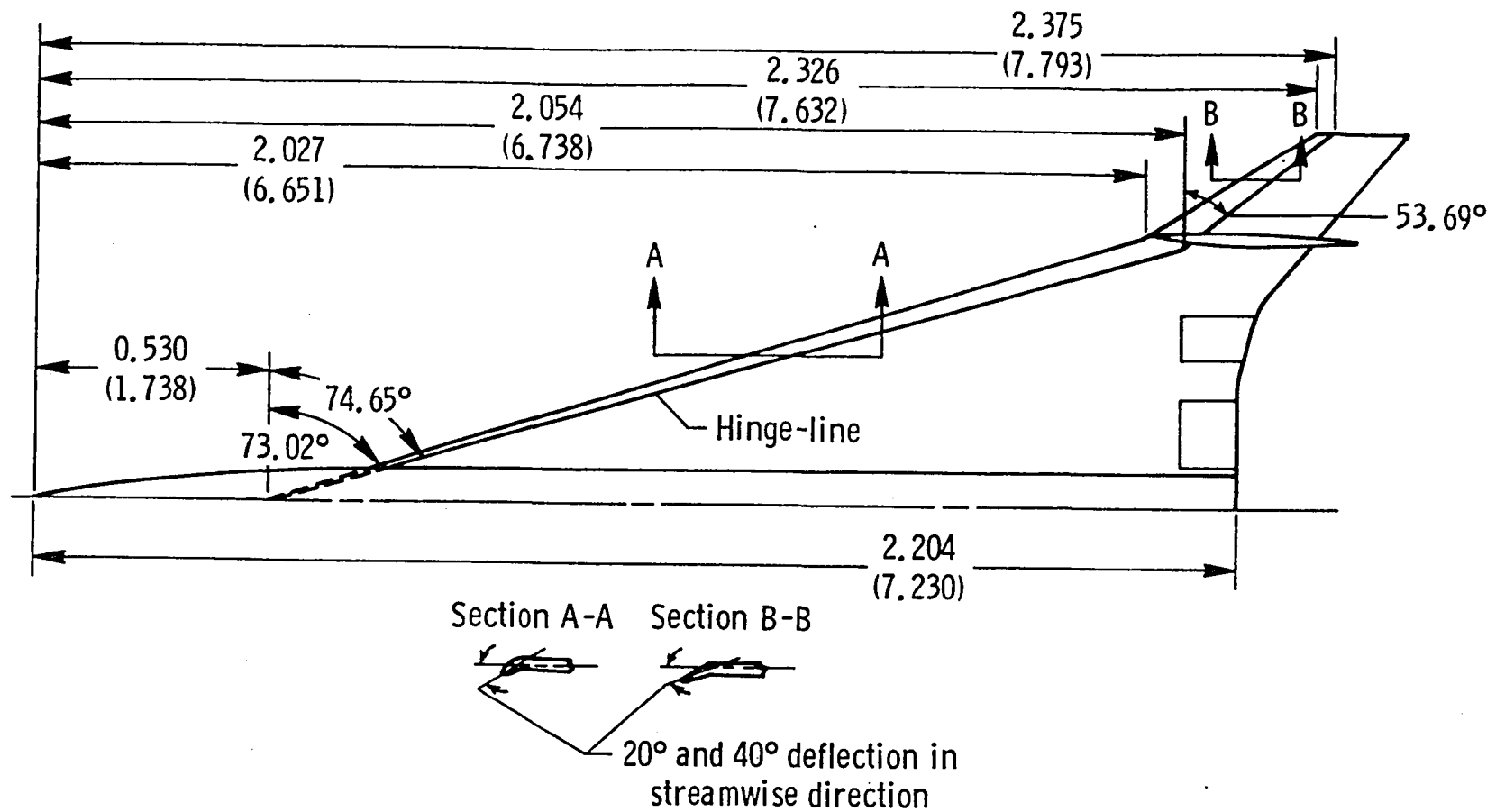
Section A-A typical



Slat brackets all streamwise

(b) Leading-Edge Slat

Figure 3. - Continued



(c) Variable Chord Leading Edge

Figure 3.- Concluded

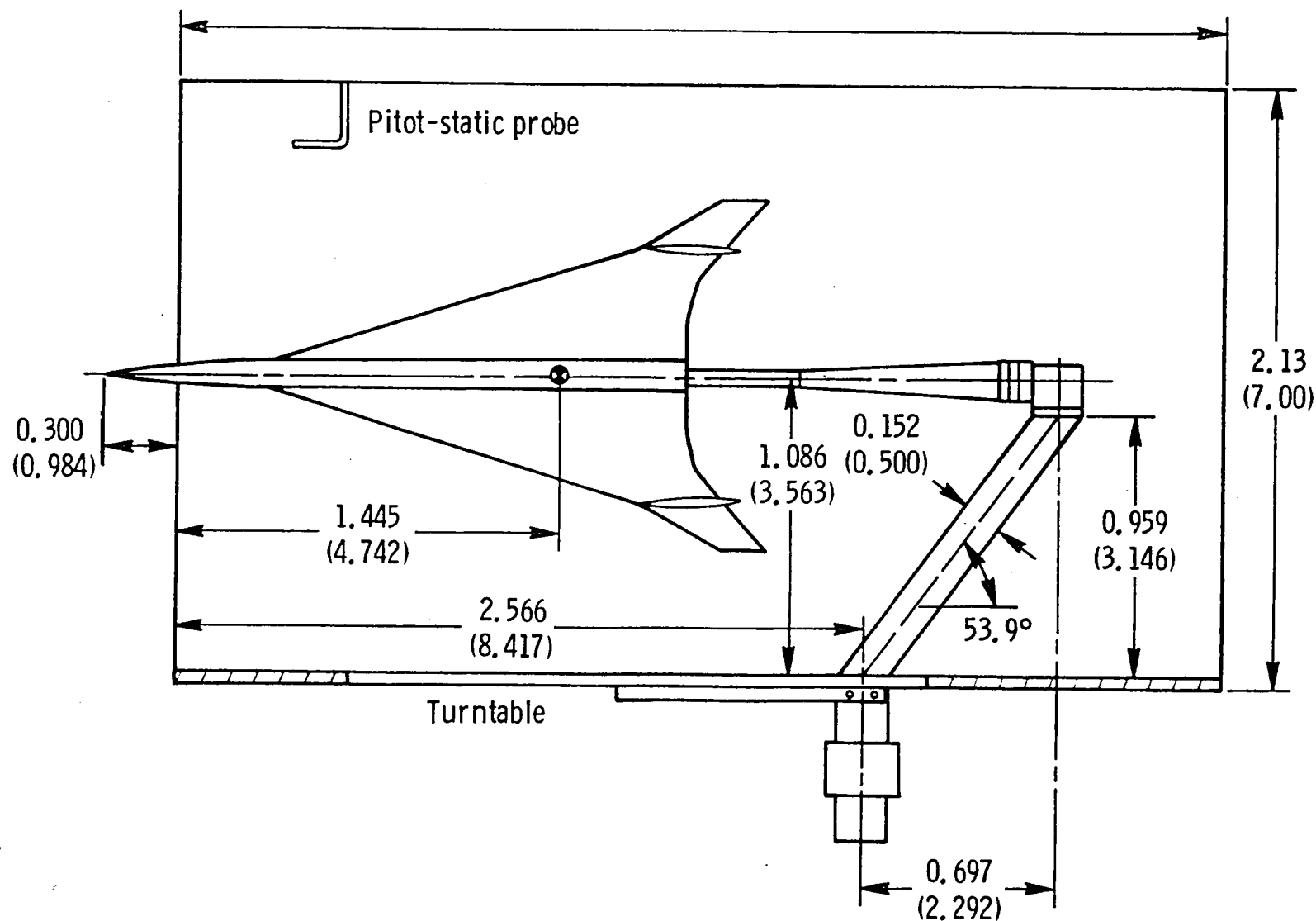
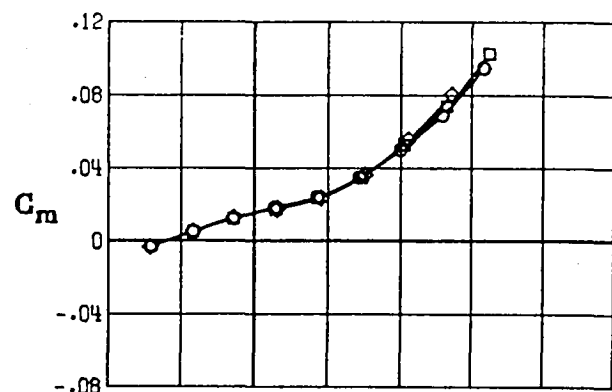


Figure 4. Model mounting arrangement in Texas A & M University 7-X 10-foot Low-Speed Wind Tunnel. Dimensions are in meters and parenthetically in feet.



Reynolds Number

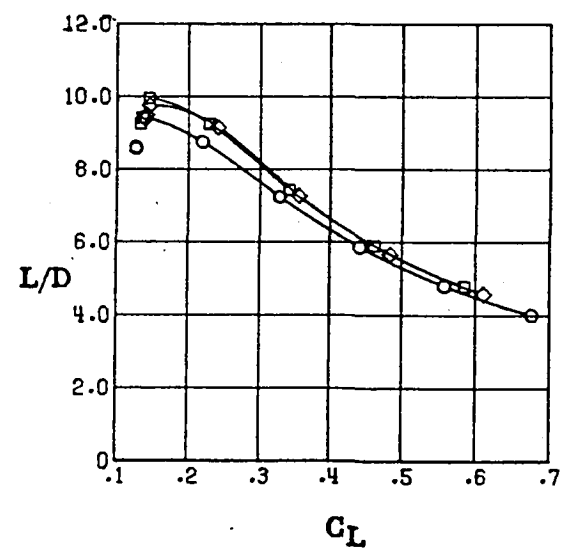
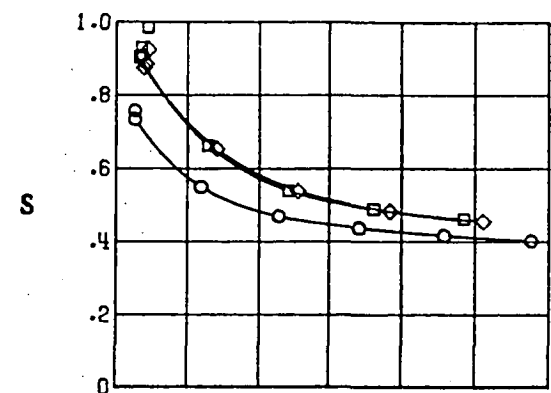
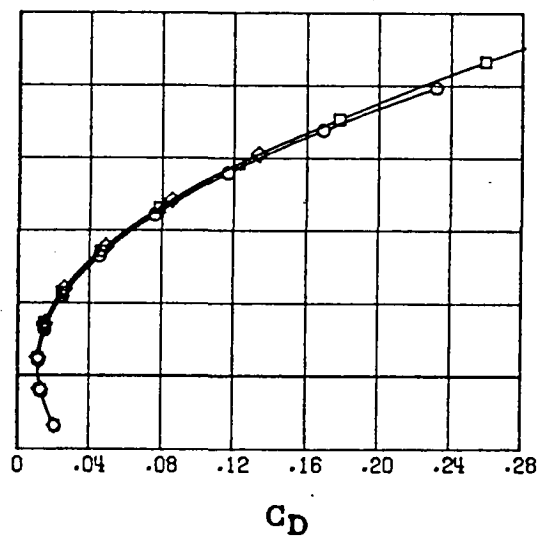
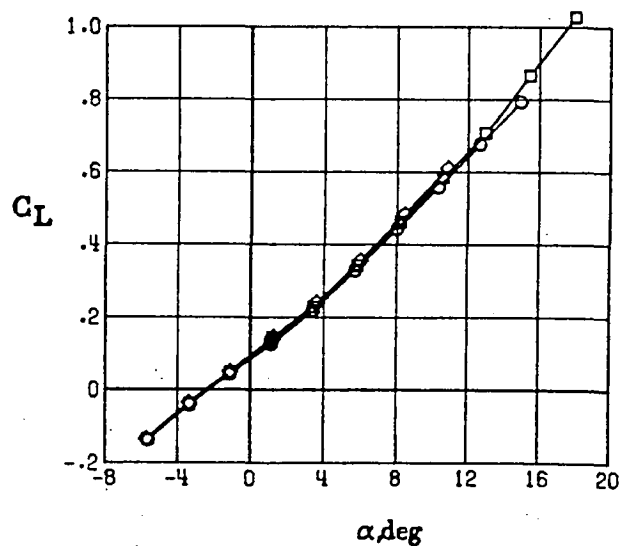
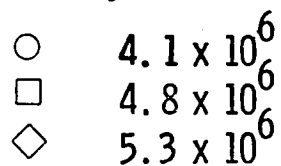
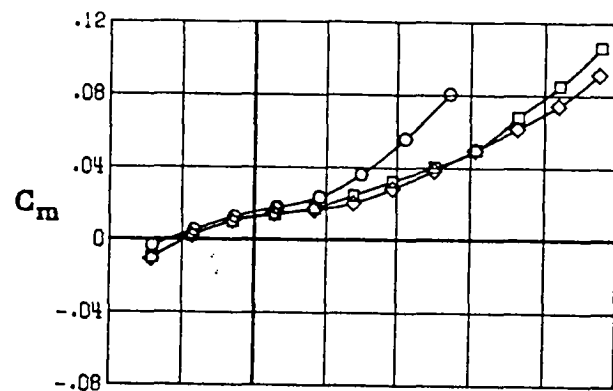


Figure 5.- Longitudinal Aerodynamic Characteristics Of Configuration With Undeflected Leading-Edge. Outboard Vertical Fins On.

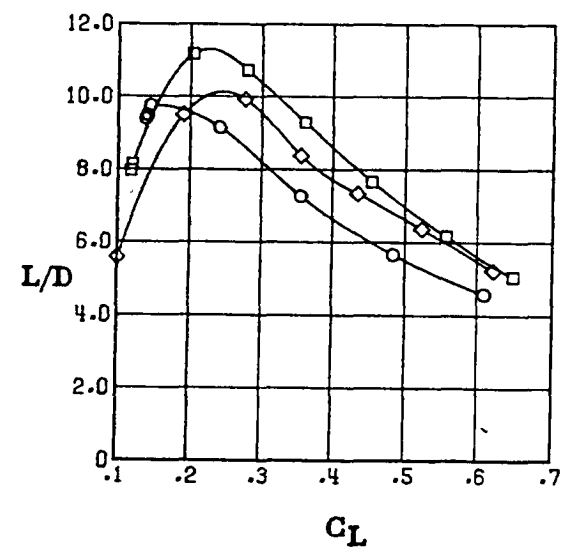
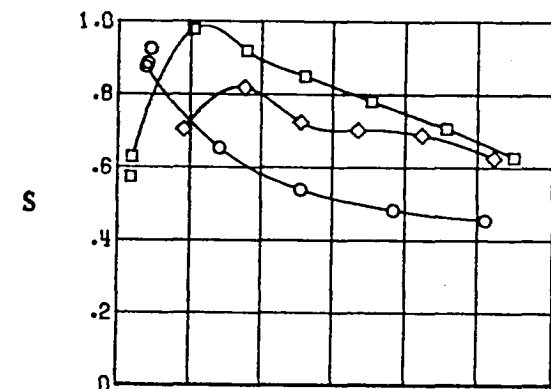
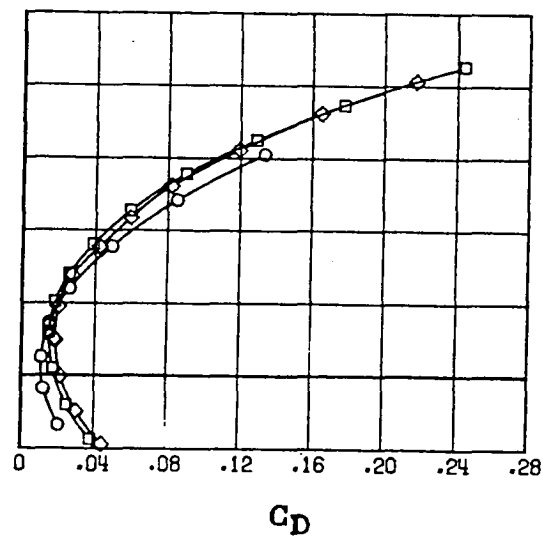
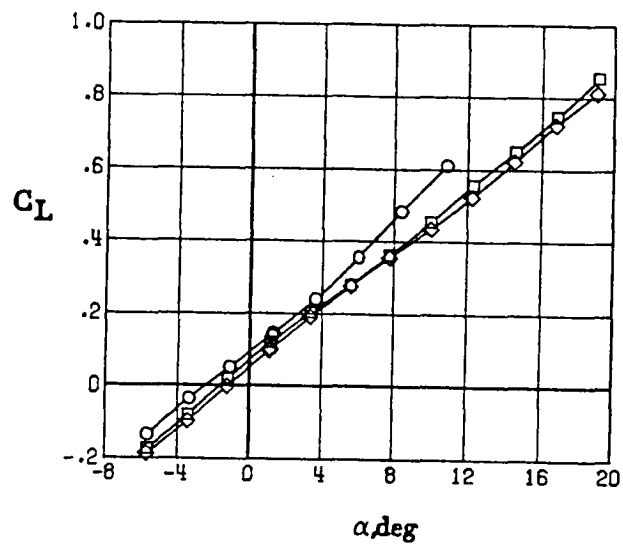


$\delta_{LE}$ , deg

○ 0

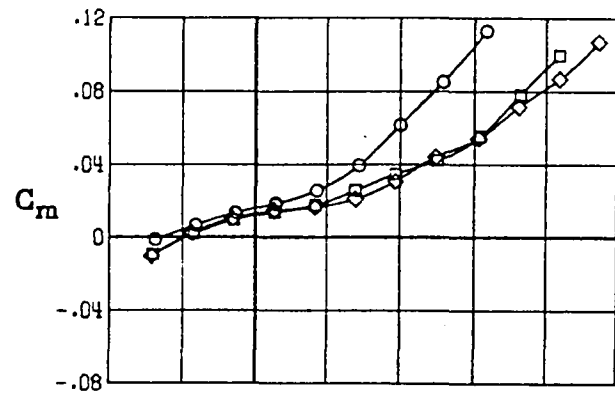
□ 30

◇ 40



(a) Vertical fins on,  $\delta_f = 0^\circ$

Figure 6.- Effect Of Simple Leading Edge Deflection.

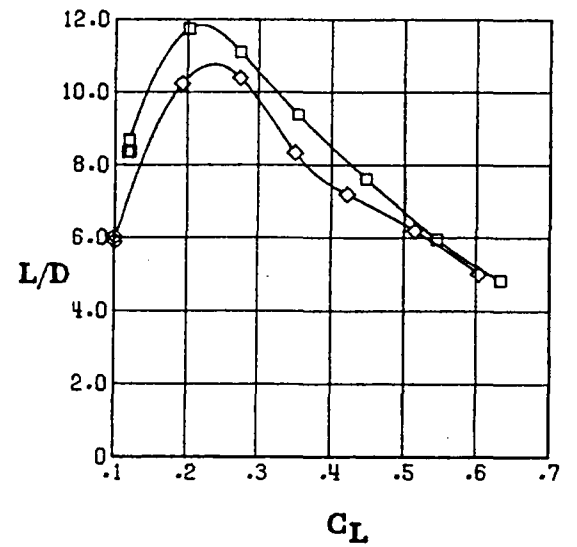
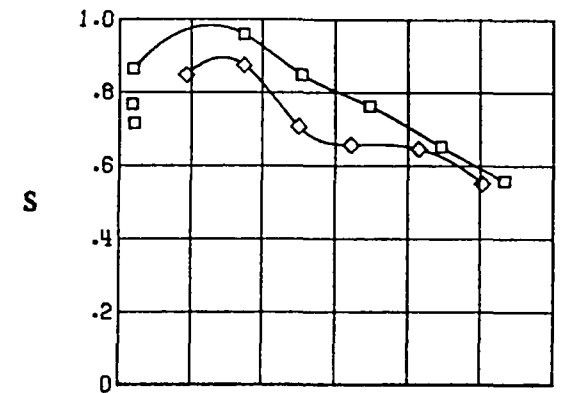
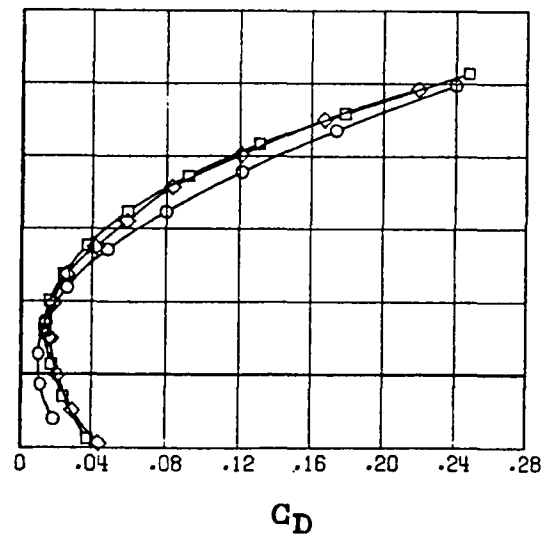
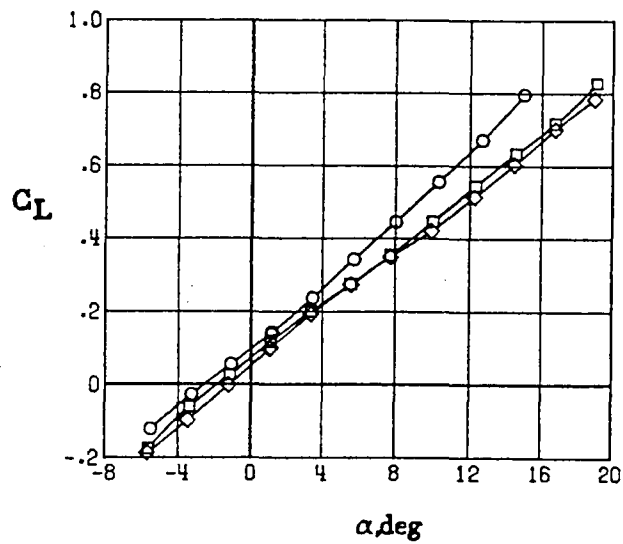


$\delta_{LE}, \text{ deg}$

○ 0

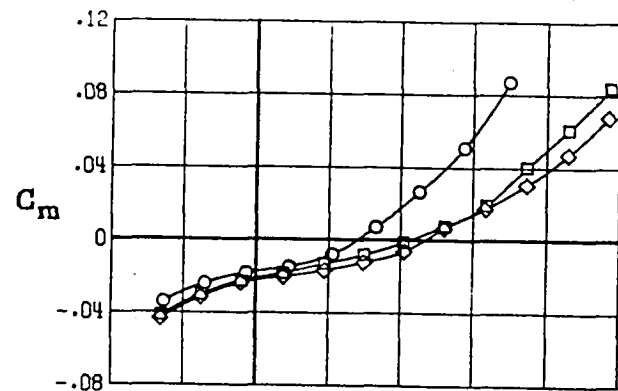
□ 30

◇ 40



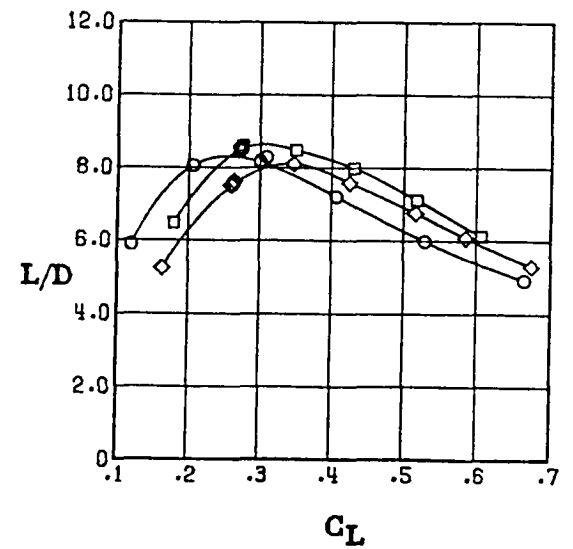
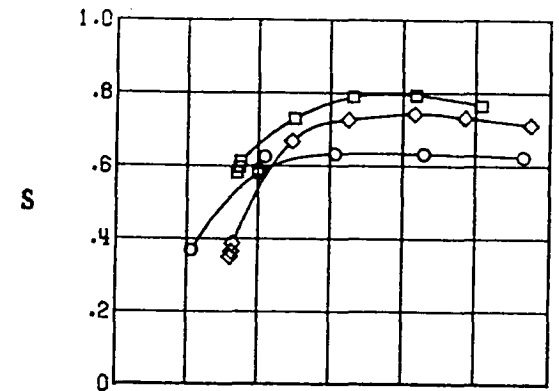
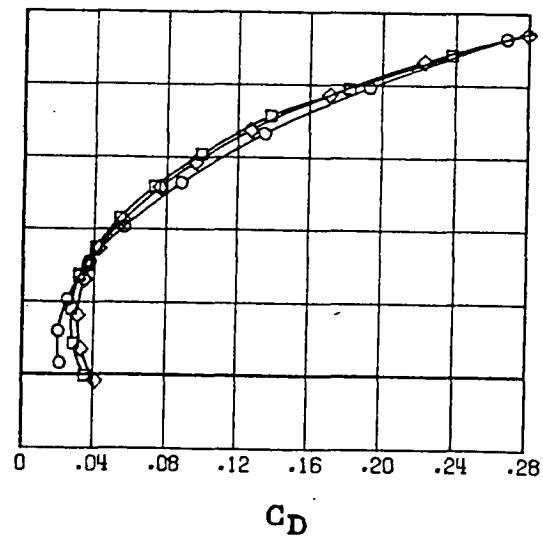
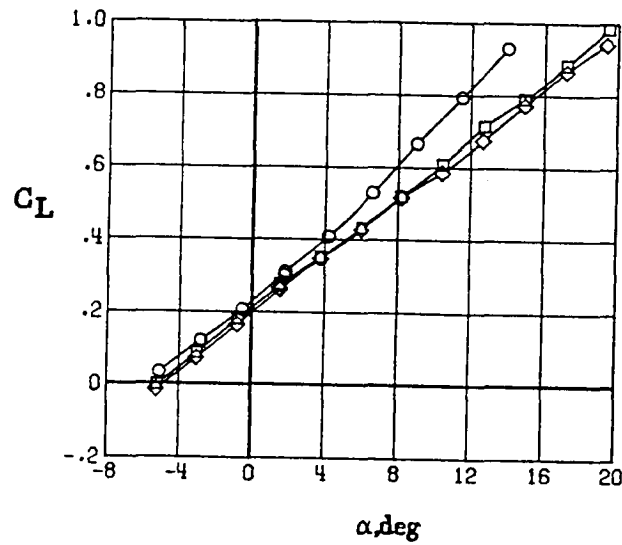
(b) Vertical fins off,  $\delta_f = 0^\circ$

Figure 6.- Continued



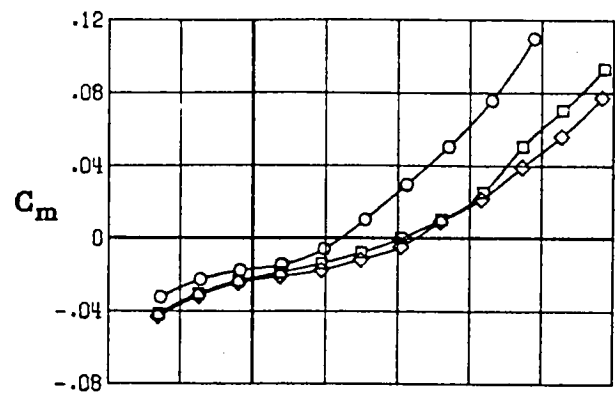
$\delta_{LE}$ , deg

- 0
- 30
- ◇ 40



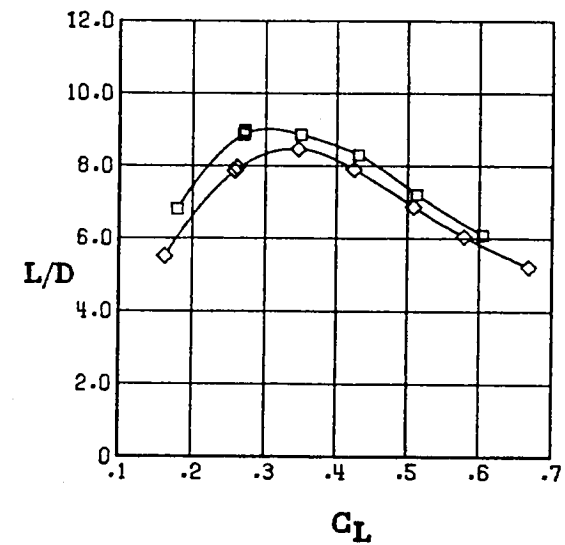
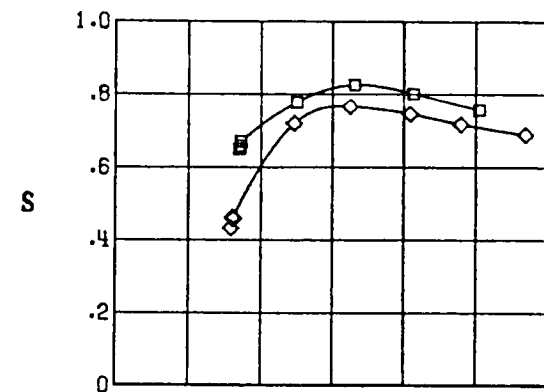
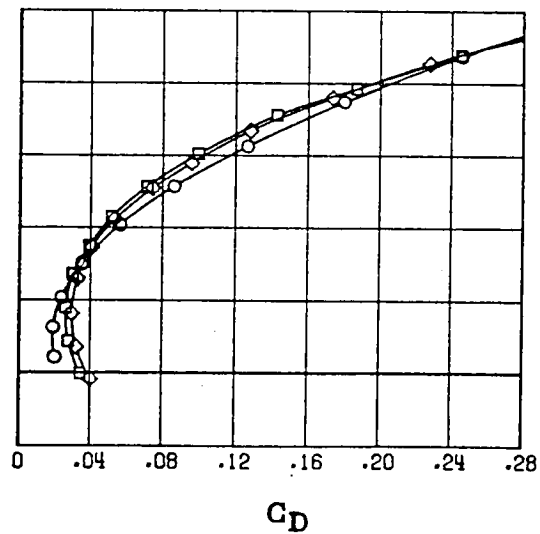
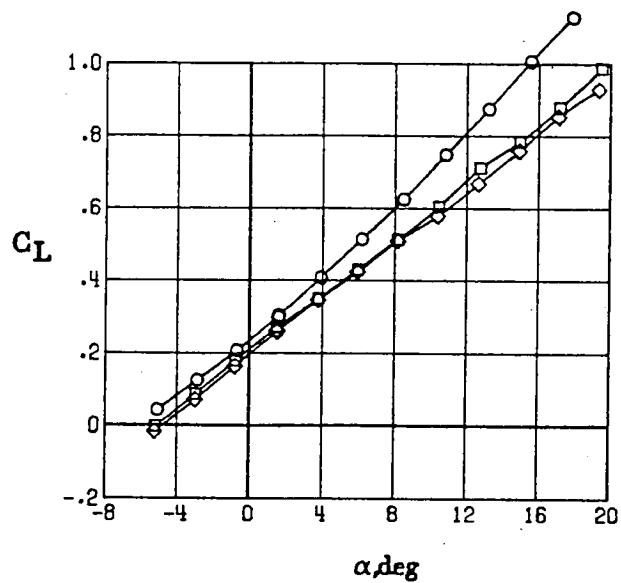
(c) Vertical fins on,  $\delta_f = 20^\circ$

Figure 6. - Continued



$\delta_{LF}$ , deg

- 0
- 30
- ◇ 40



(d) Vertical fins off,  $\delta_f = 20^\circ$

Figure 6. - Concluded



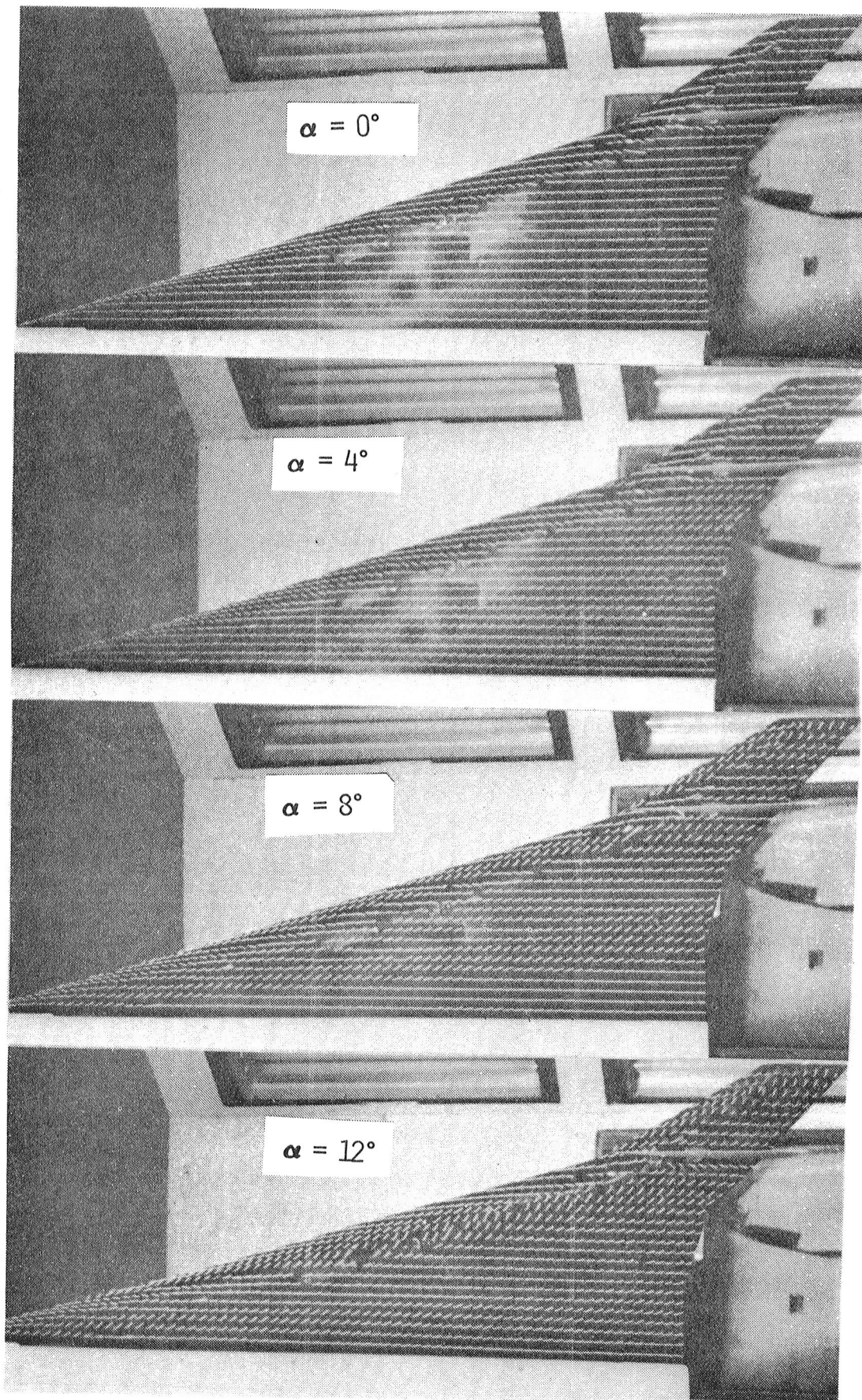
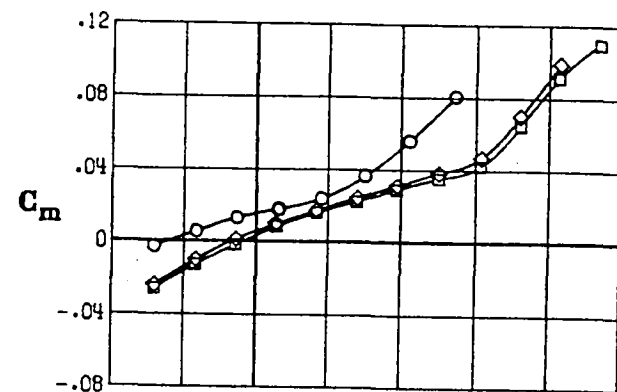
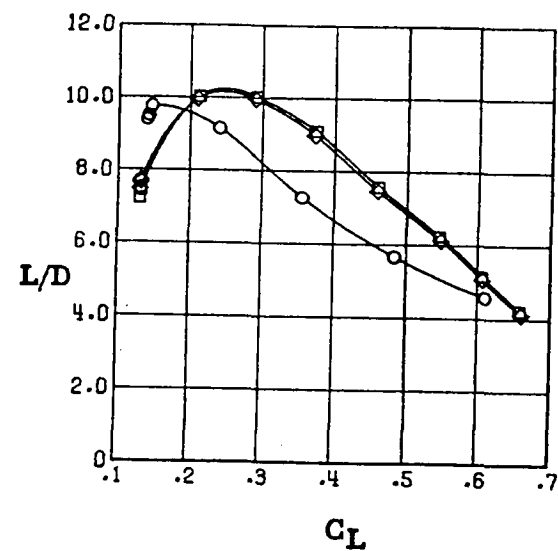
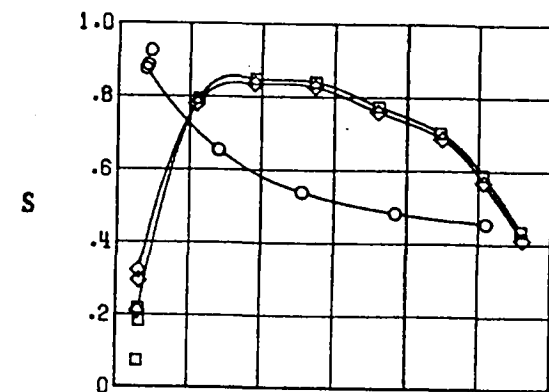
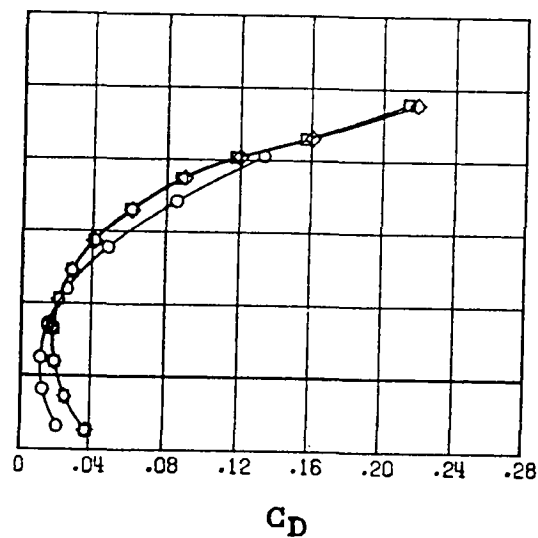
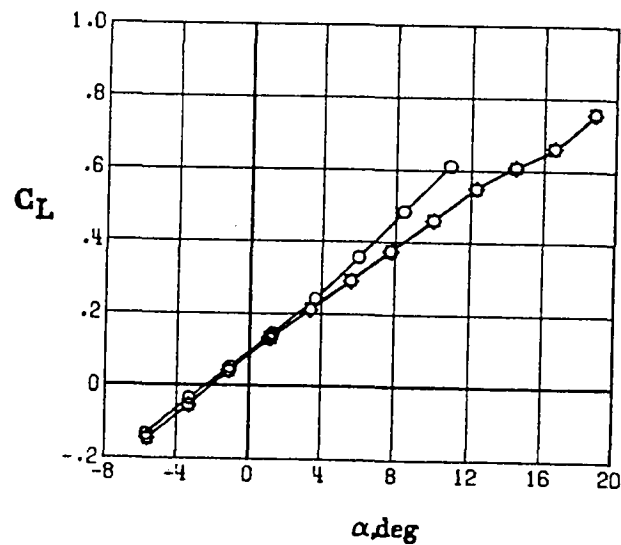


Figure 7. - Tuft Photographs of the Configuration With Simply Deflected Leading Edge ( $\delta_{LE} = 30^\circ$ ).



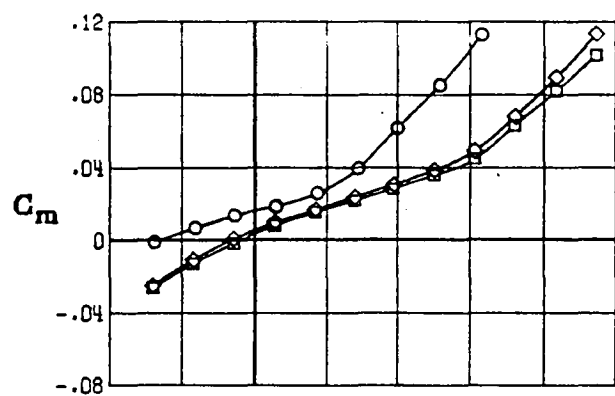
Leading-edge

- Undeflected
- Slat, I (see fig. 3b)
- ◇ Slat, II (see fig. 3b)

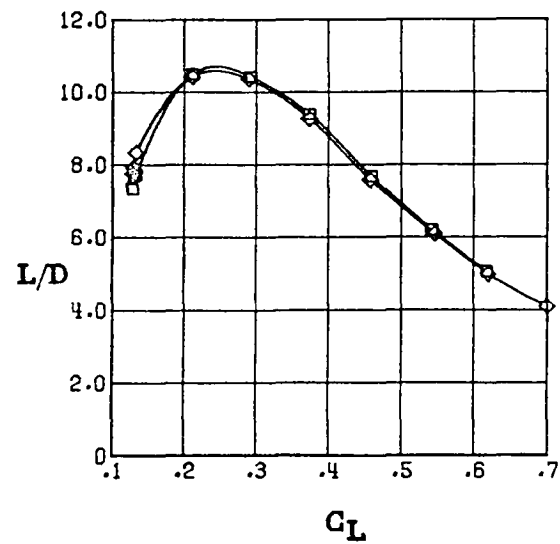
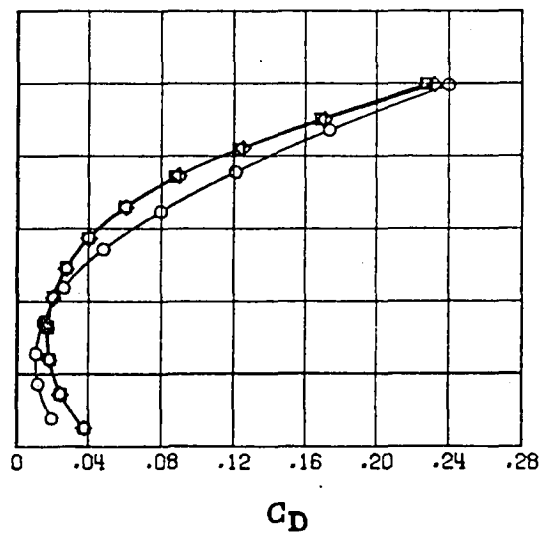
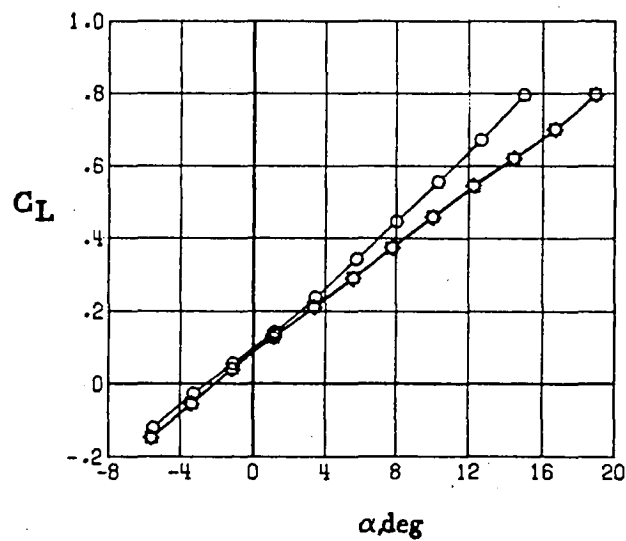
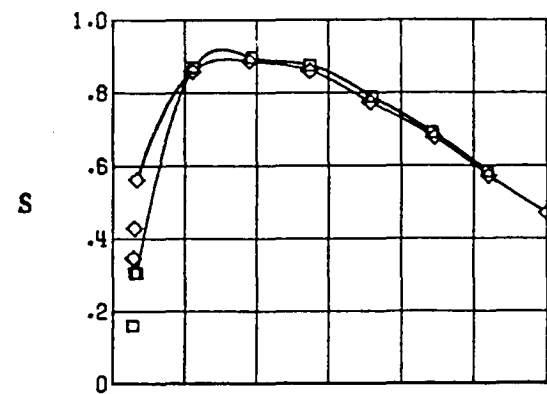


(a) Vertical fins on,  $\delta_f = 0^\circ$

Figure 8.- Effect Of Leading-Edge Slat On Longitudinal Aerodynamic Characteristics.

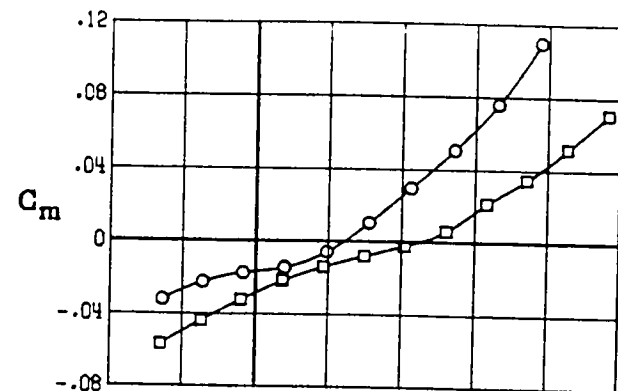


Leading-edge  
 ○ Undelected  
 □ Slat, I (see fig. 3b)  
 ◇ Slat, II (see fig. 3b)

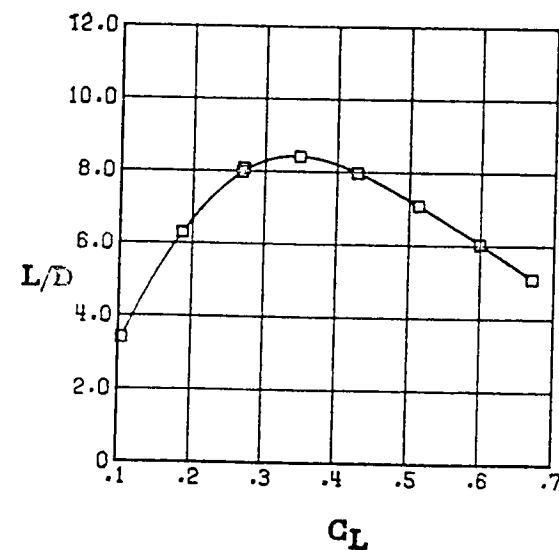
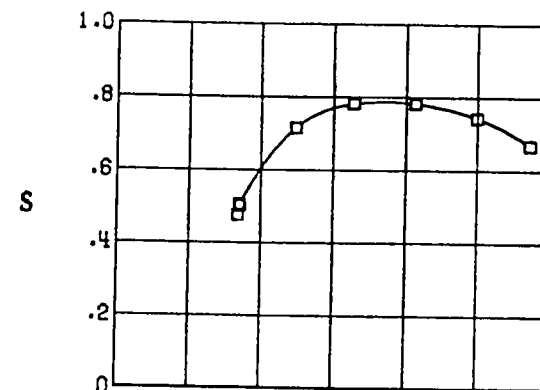
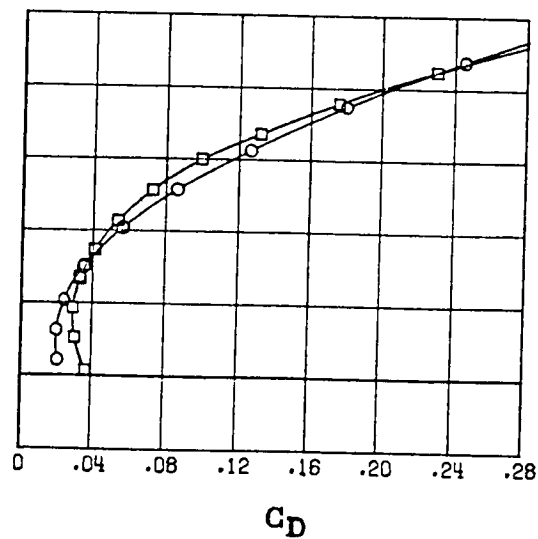
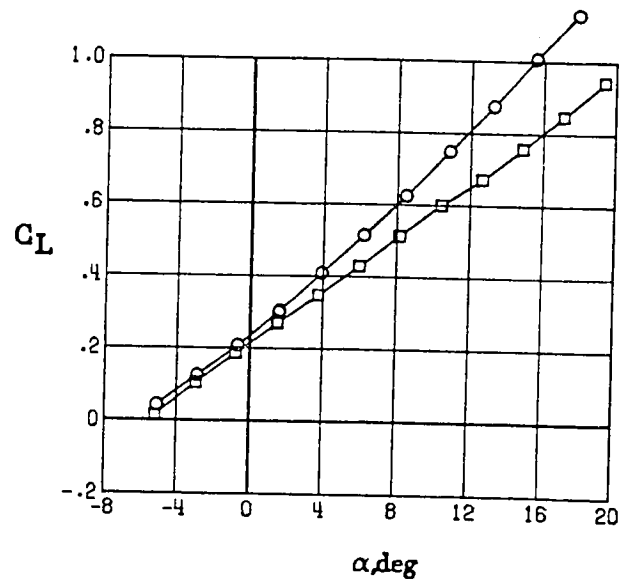


(b) Vertical fins off,  $\delta_f = 0^\circ$ .

Figure 8. - Continued



Leading-edge  
 ○ Undeflected  
 □ Slat, I (see fig. 3b)



(c) Vertical fins off,  $\delta_f = 20^\circ$ .

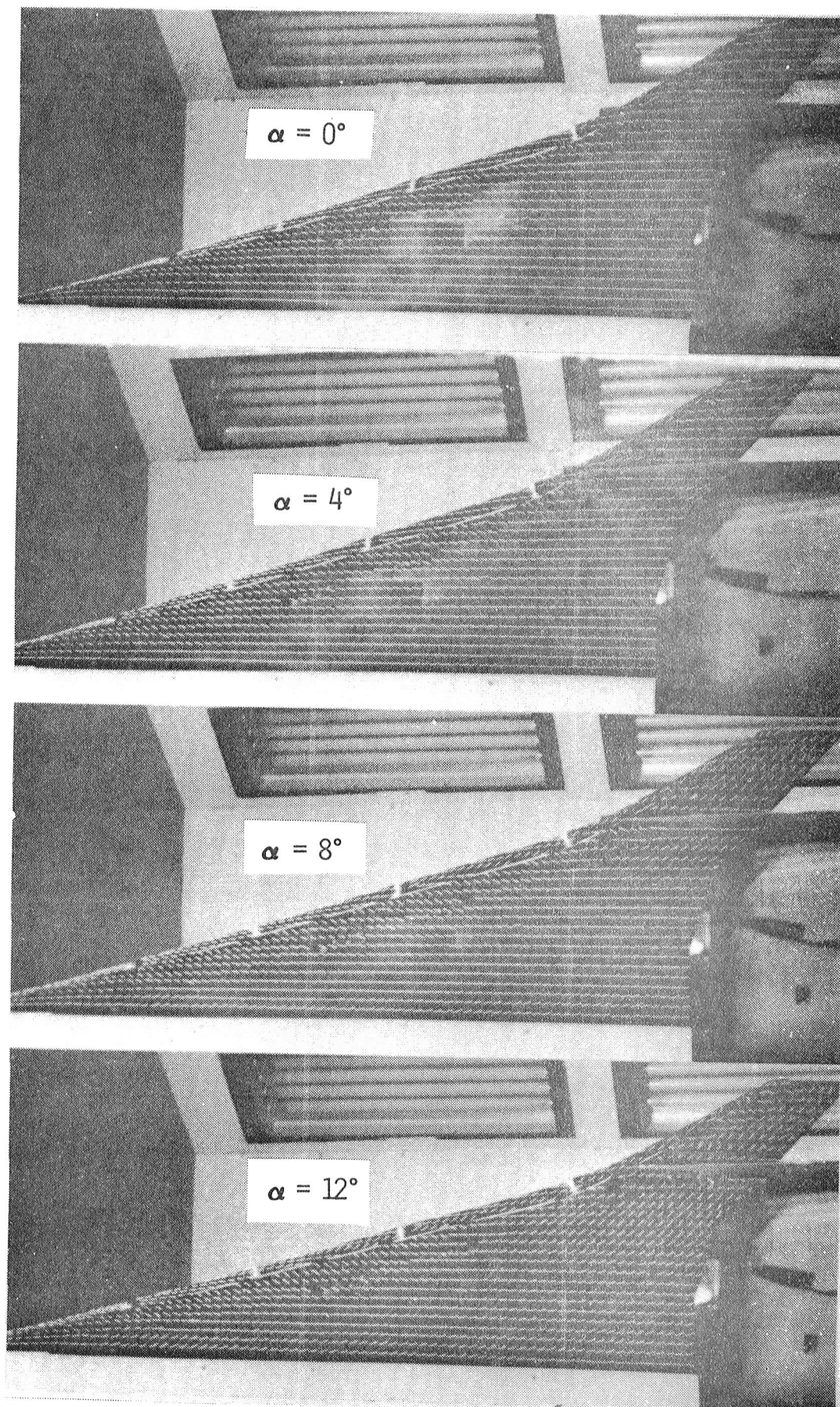
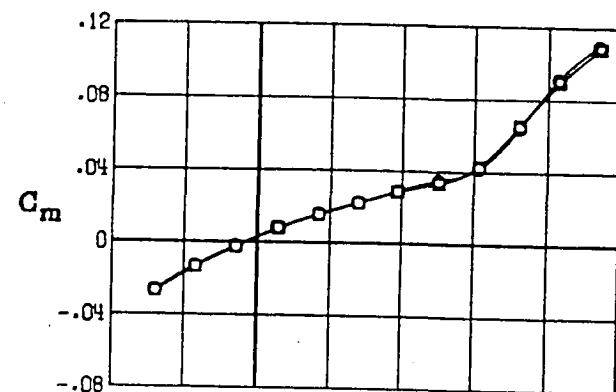
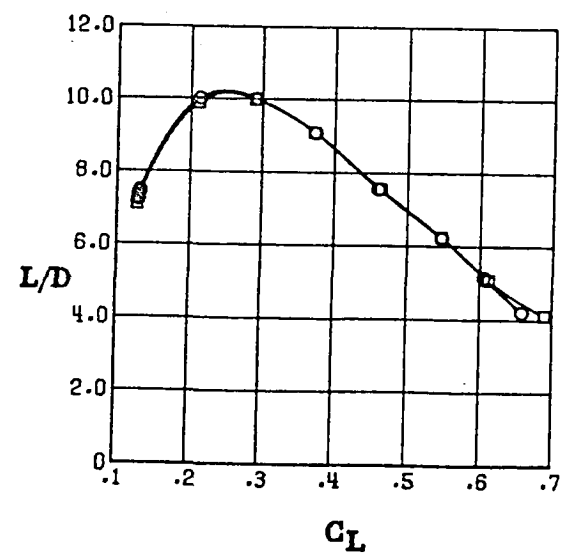
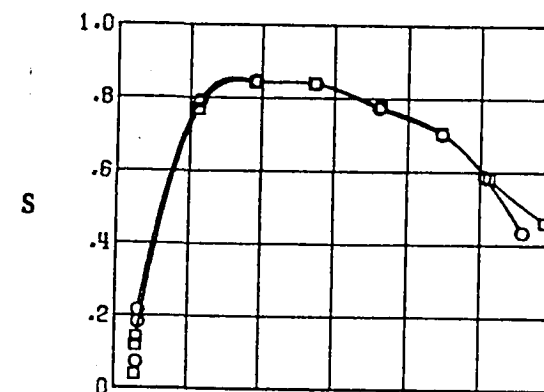
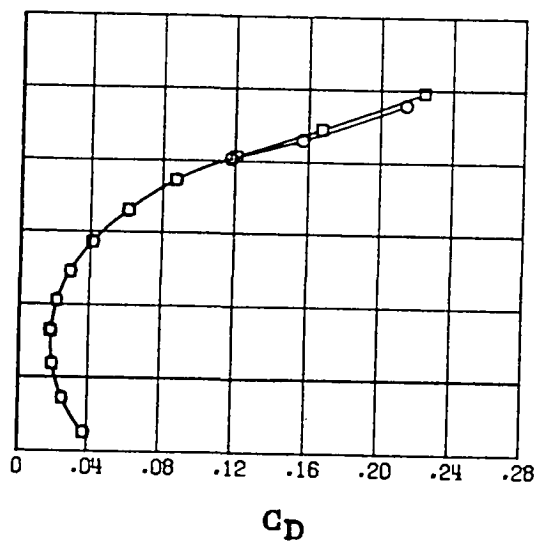
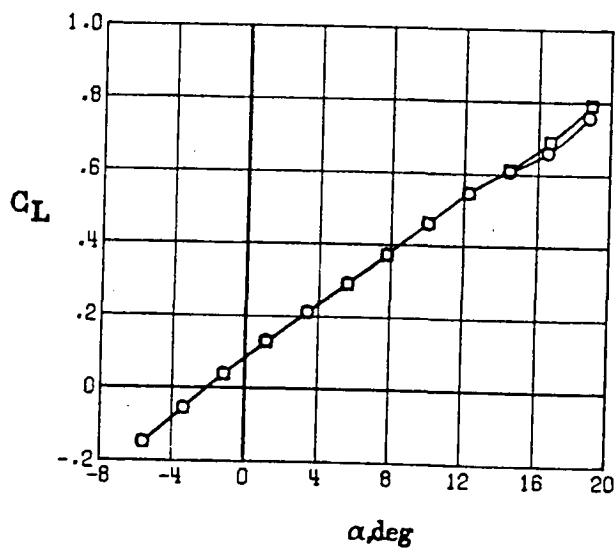


Figure 9. - Tuft Photographs of the Configuration With Leading Edge Slats.



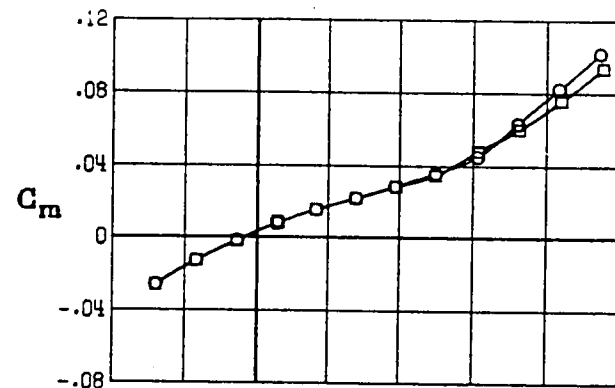
Intersegment joints  
 ○ Sealed  
 □ Unsealed



(a) Slat I, vertical fins on.

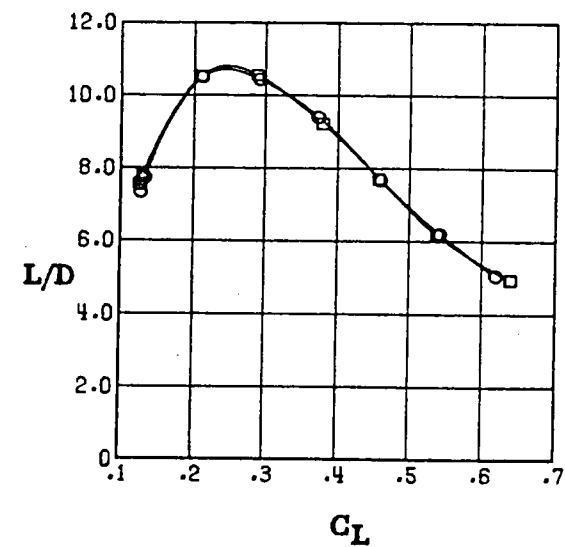
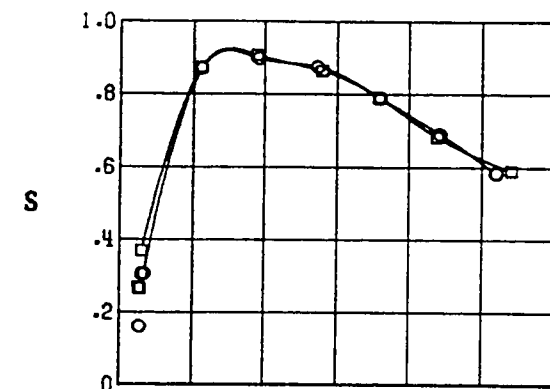
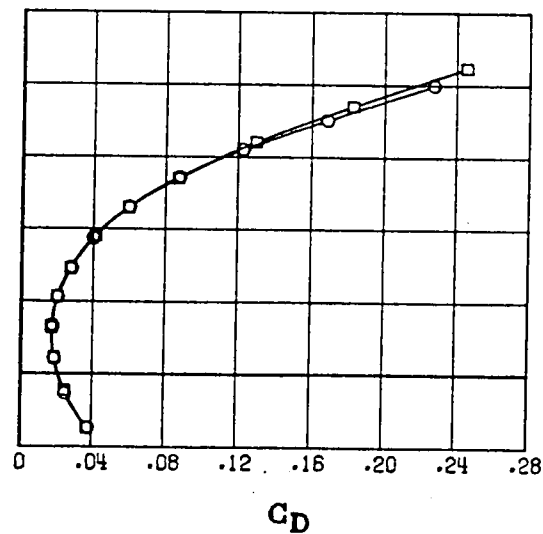
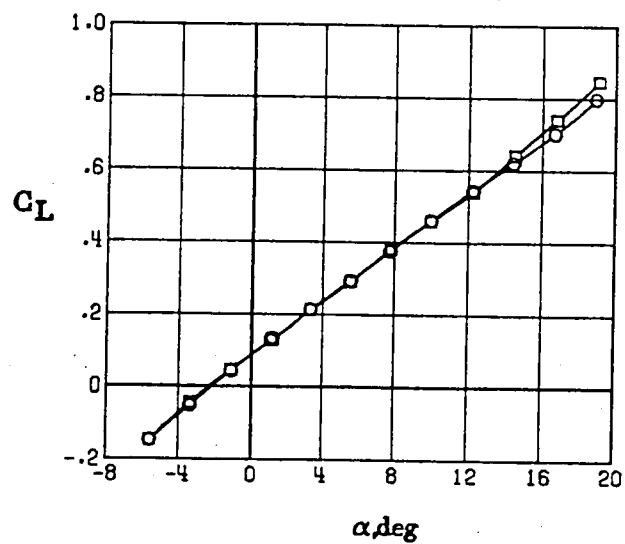
Figure 10. - Effect Of Sealing Intersegment Joints Of Leading Edge Slat Configurations.  $\delta_f = 0^\circ$





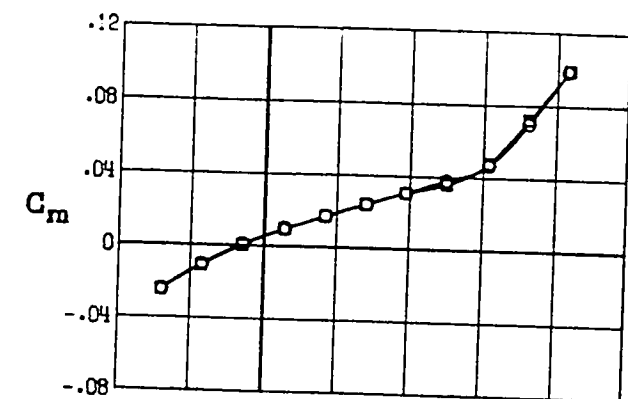
Intersegment joints

- Sealed
- Unsealed



(b) Slat I, vertical fins off

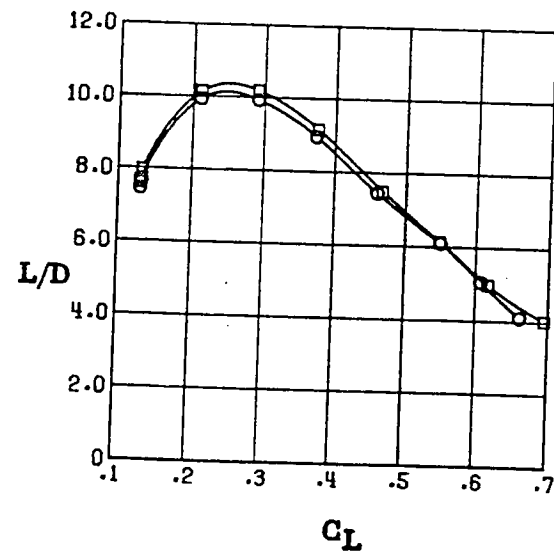
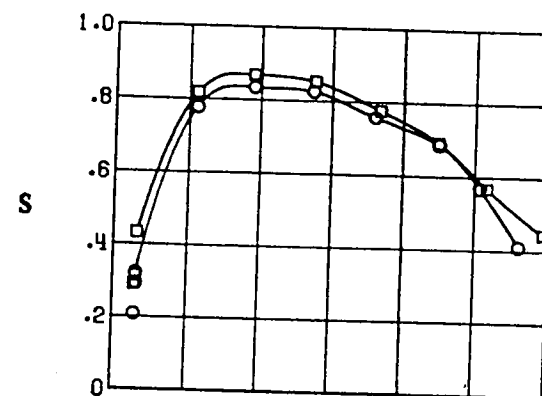
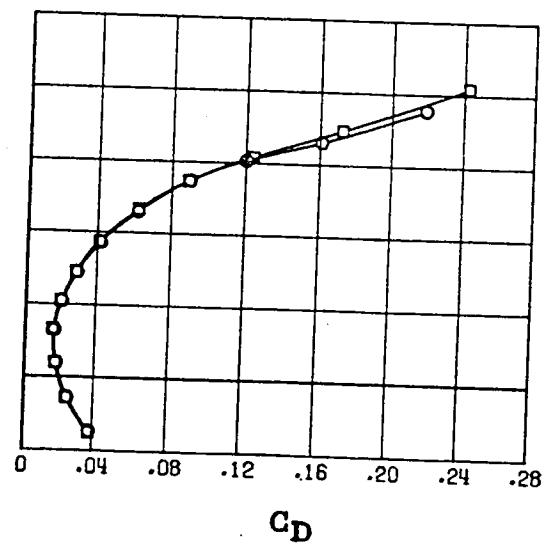
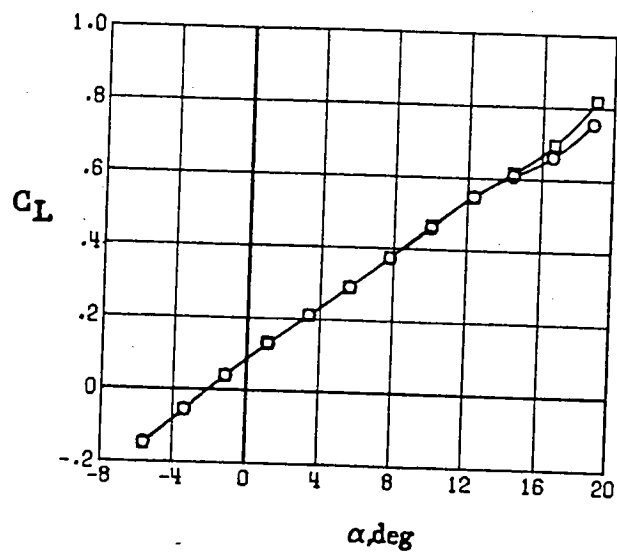
Figure 10.- Continued



Intersegment joints

○ Sealed

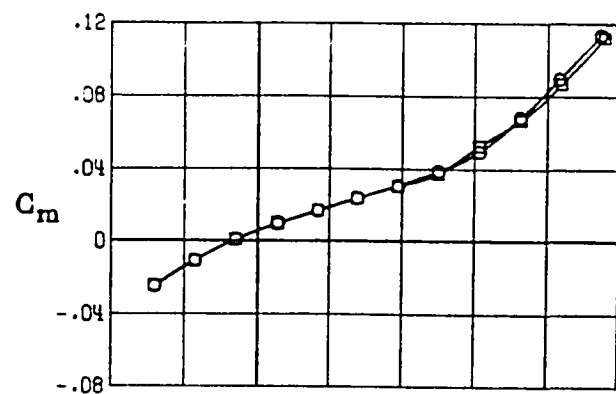
□ Unsealed



(c) Slat II, vertical fins on.

Figure 10.- Continued

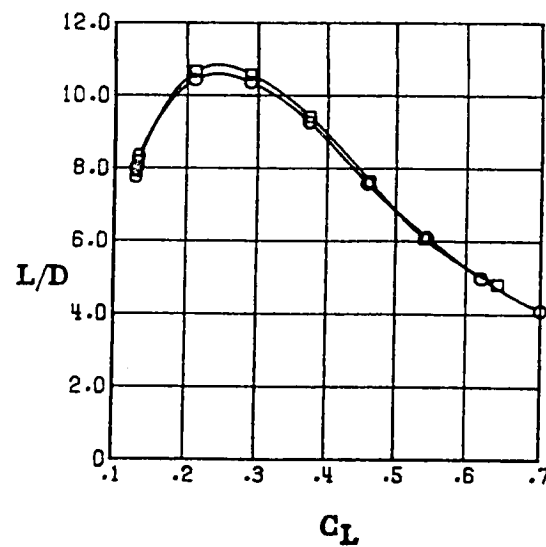
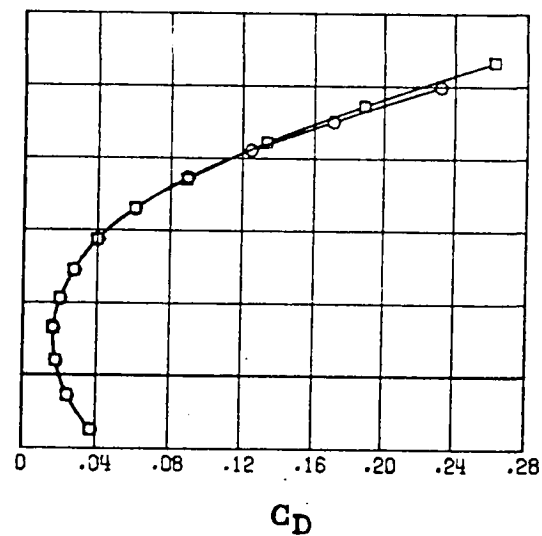
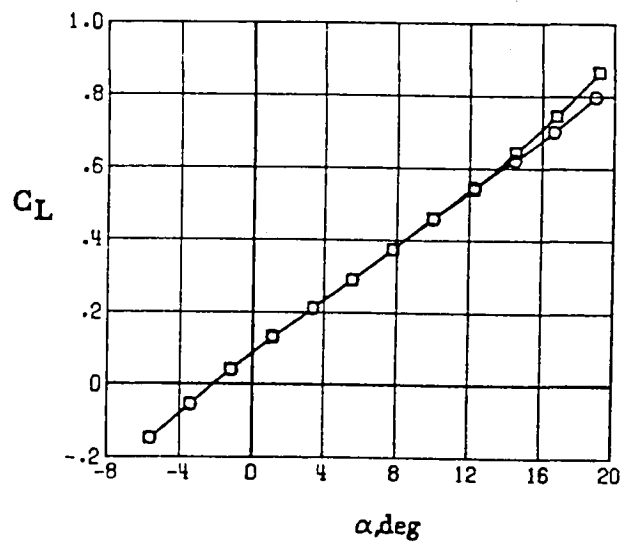
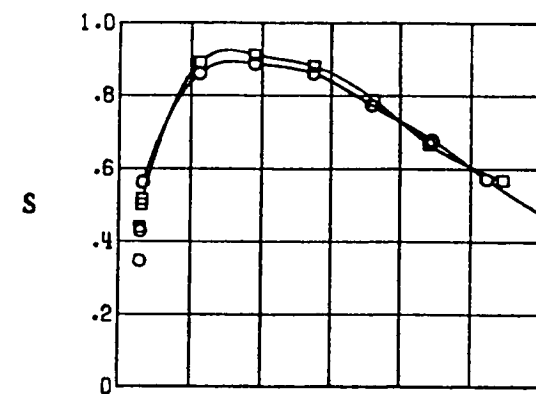




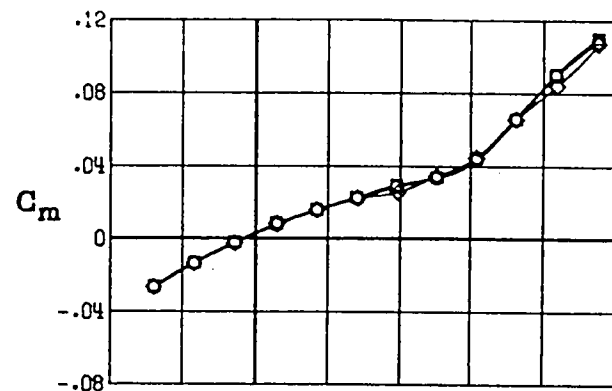
Intersegment joints

○ Sealed

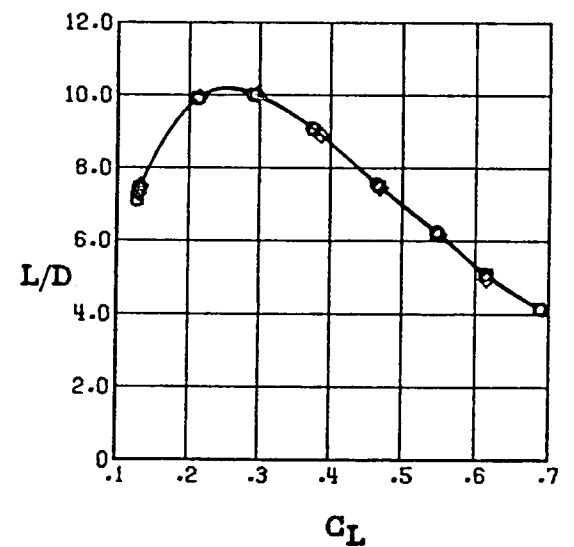
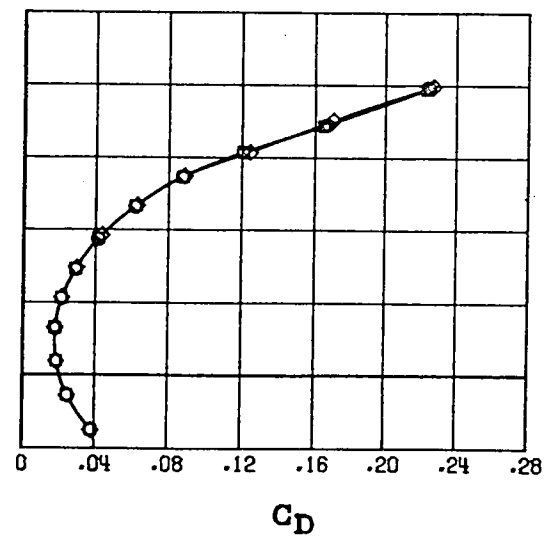
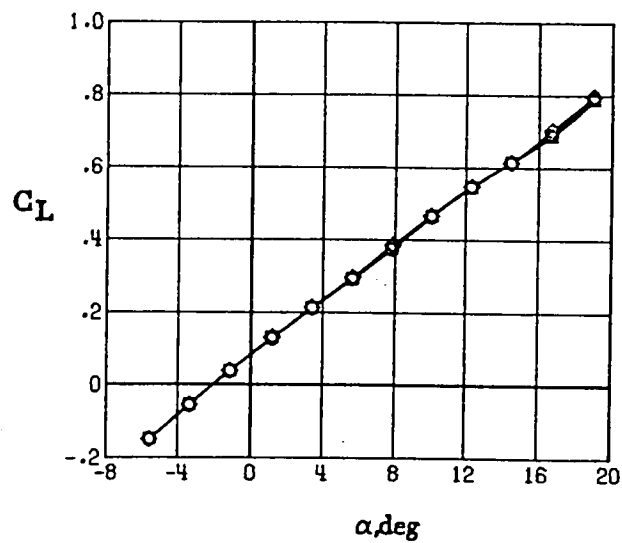
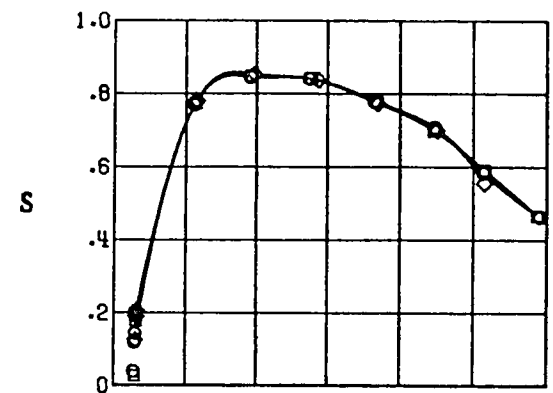
□ Unsealed



(d) Slat II, vertical fins off.

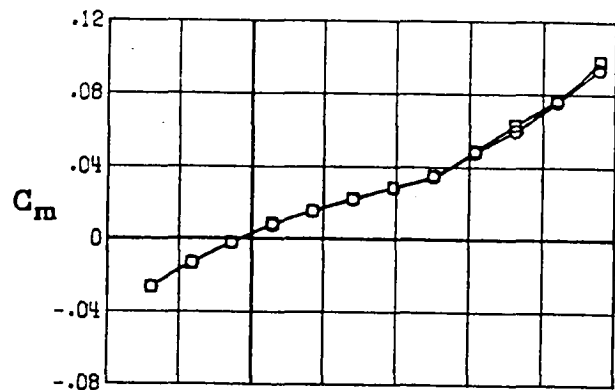


- Slat configuration
- Nominal setting
  - Large gap (see fig. 3b)
  - ◇ Large gap with outboard wing panel gap sealed



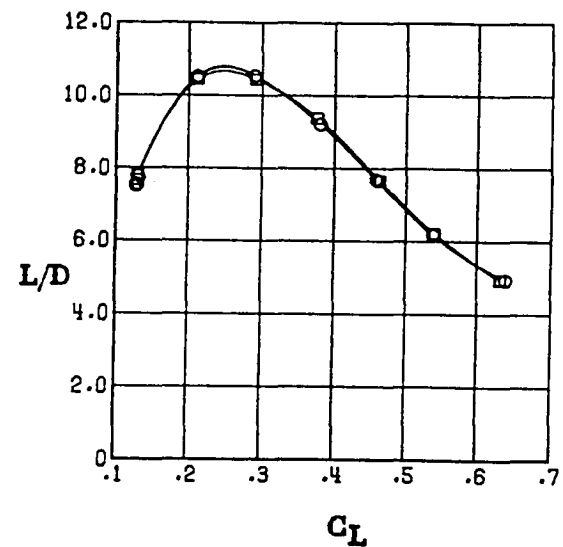
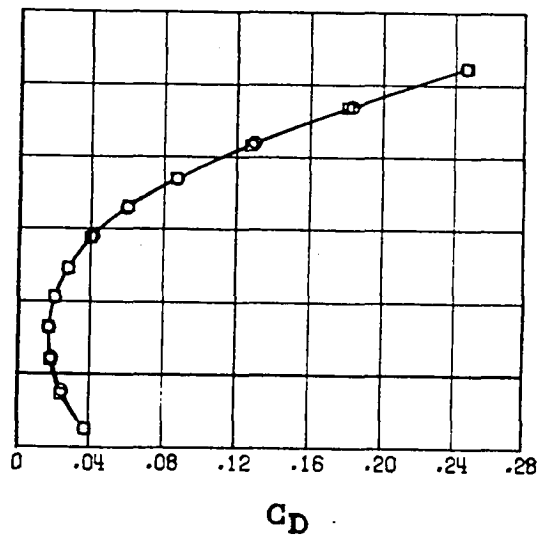
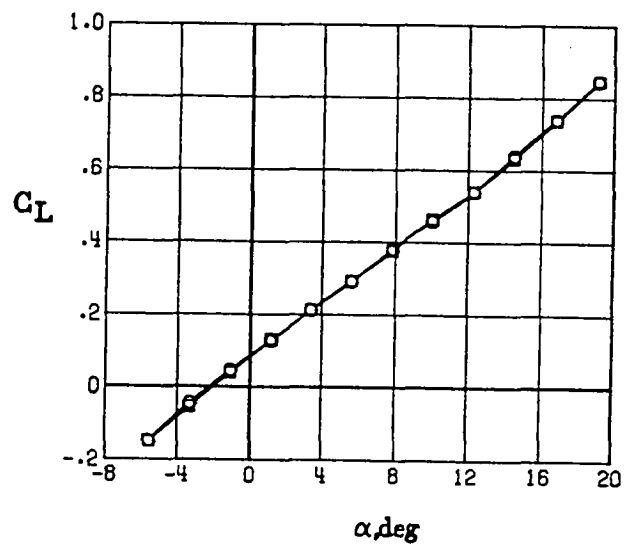
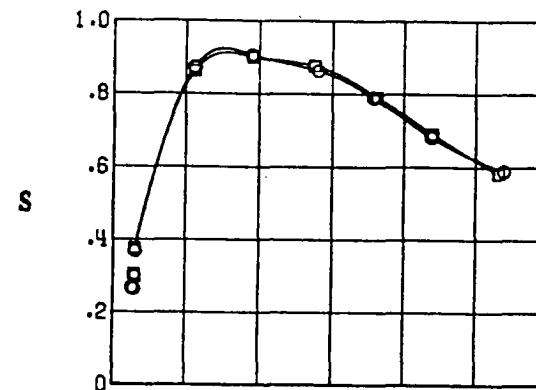
(a) Vertical fins on.

Figure 11.- Effect Of Slat Gap. Slat I.



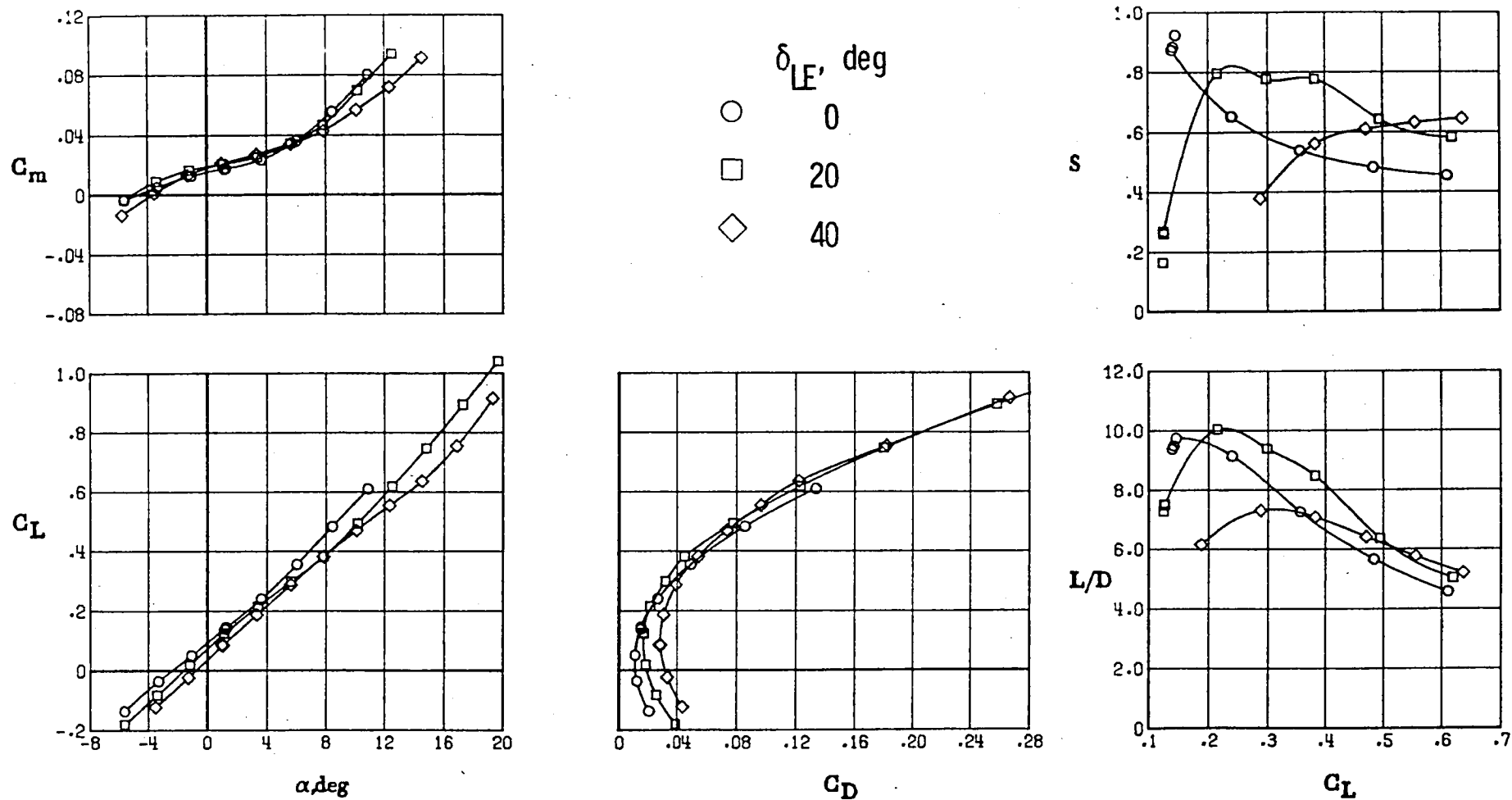
Slat configuration

- Nominal setting
- Large gap (see fig. 3b)
- ◇ Large gap with outboard wing panel gap sealed



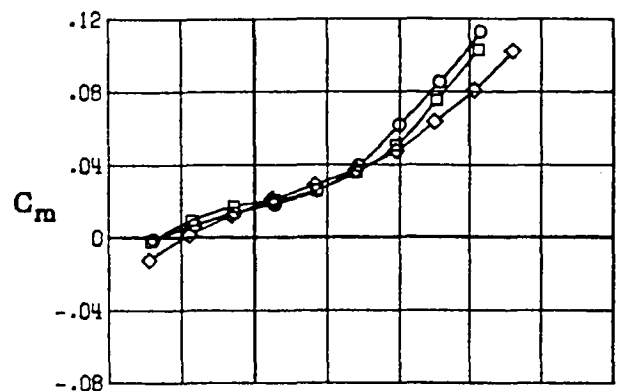
(b) Vertical fins off.

Figure 11. - Concluded



(a) Vertical fins on,  $\delta_f = 0^\circ$ .

Figure 12. - Effect Of Variable Chord Leading-Edge Deflection On Longitudinal Aerodynamic Characteristics

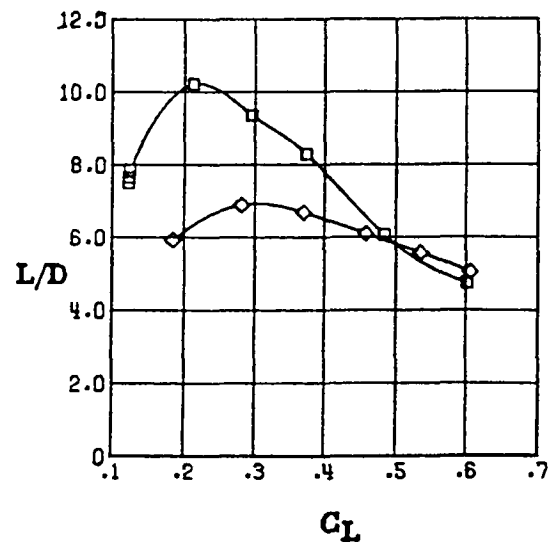
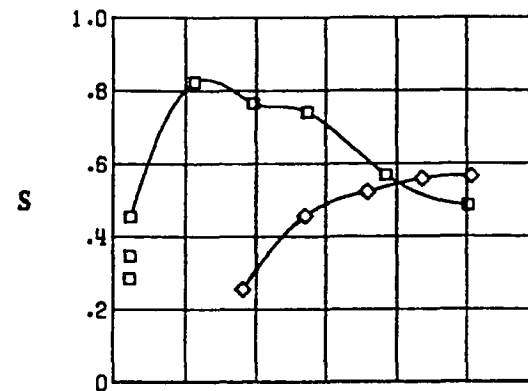
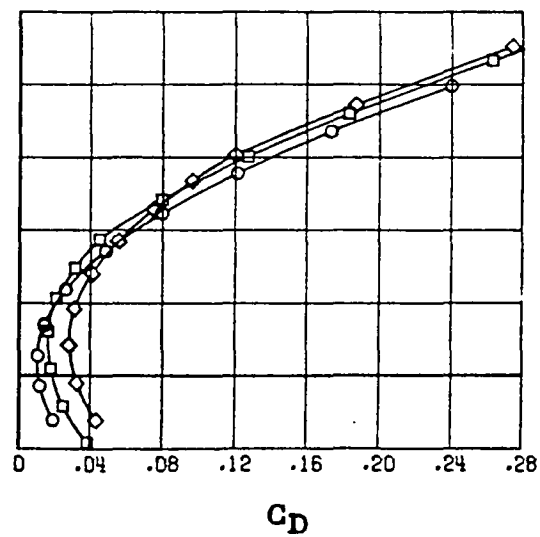
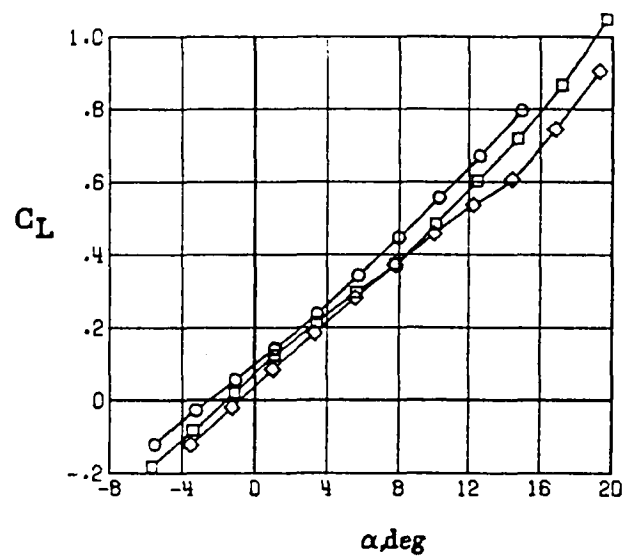


$\delta_{LE}$ , deg

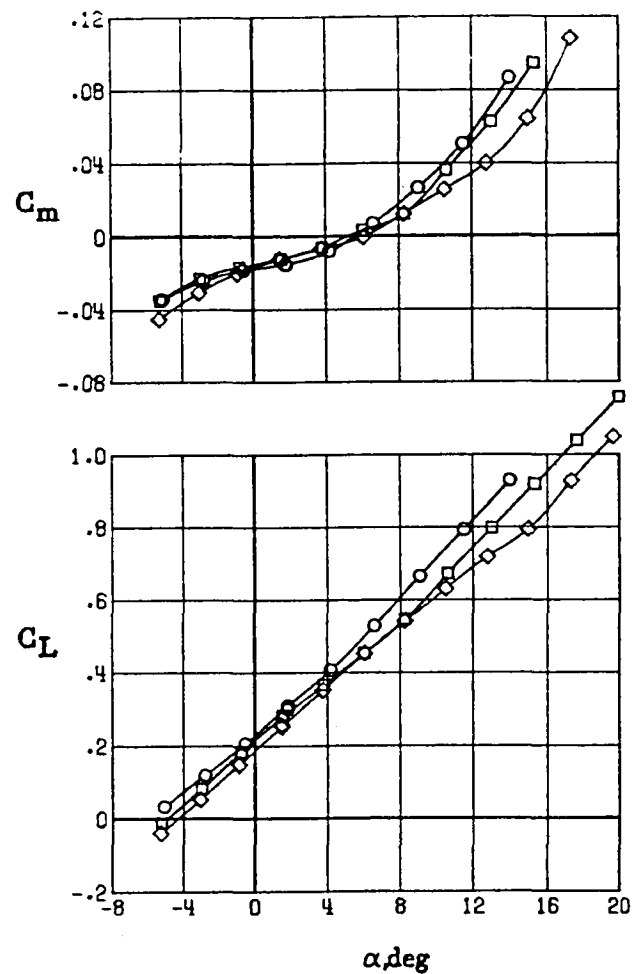
○ 0

□ 20

◇ 40

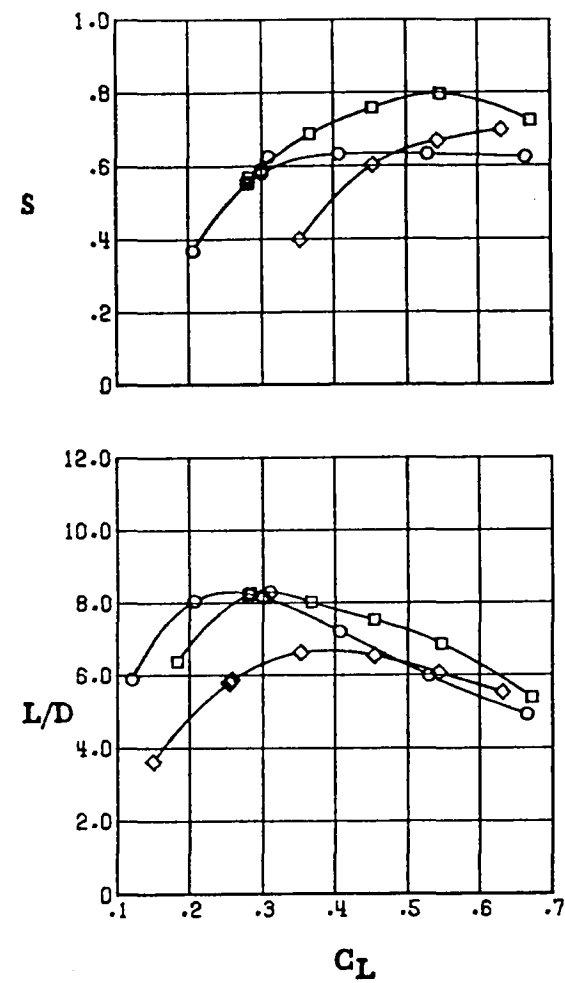
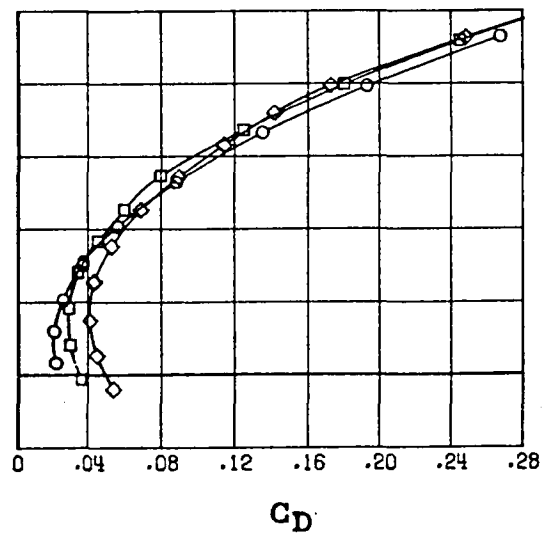


(b) Vertical fins off,  $\delta_f = 0^\circ$ .



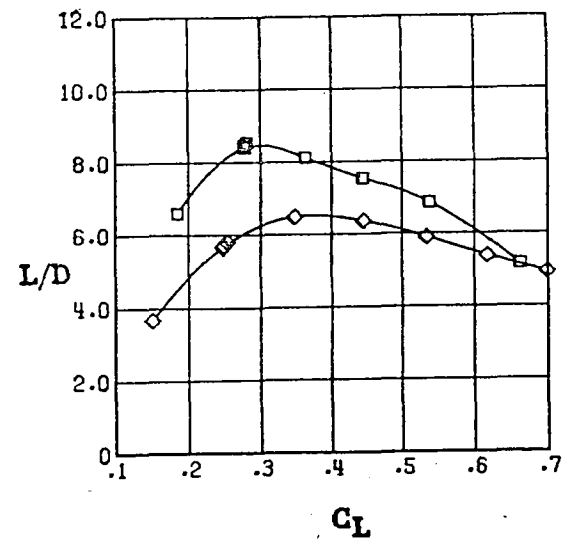
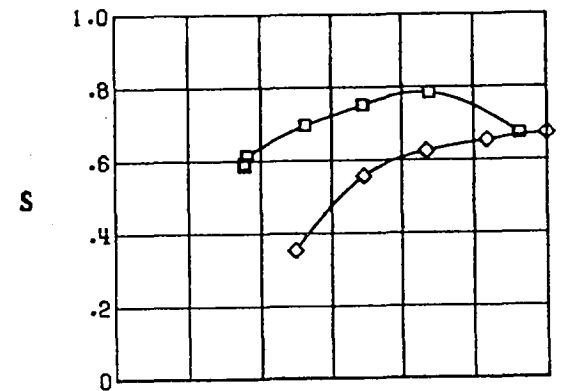
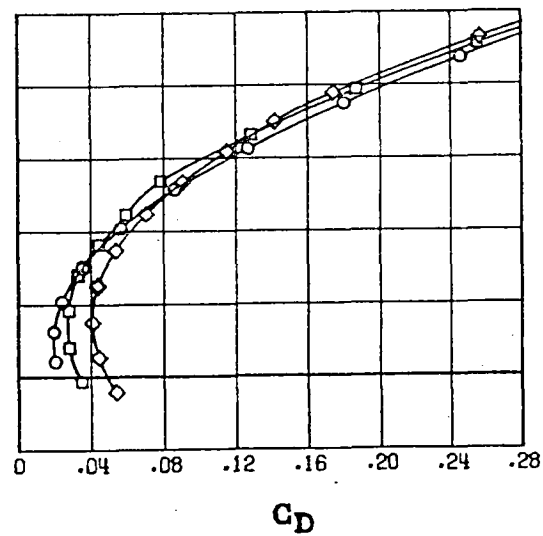
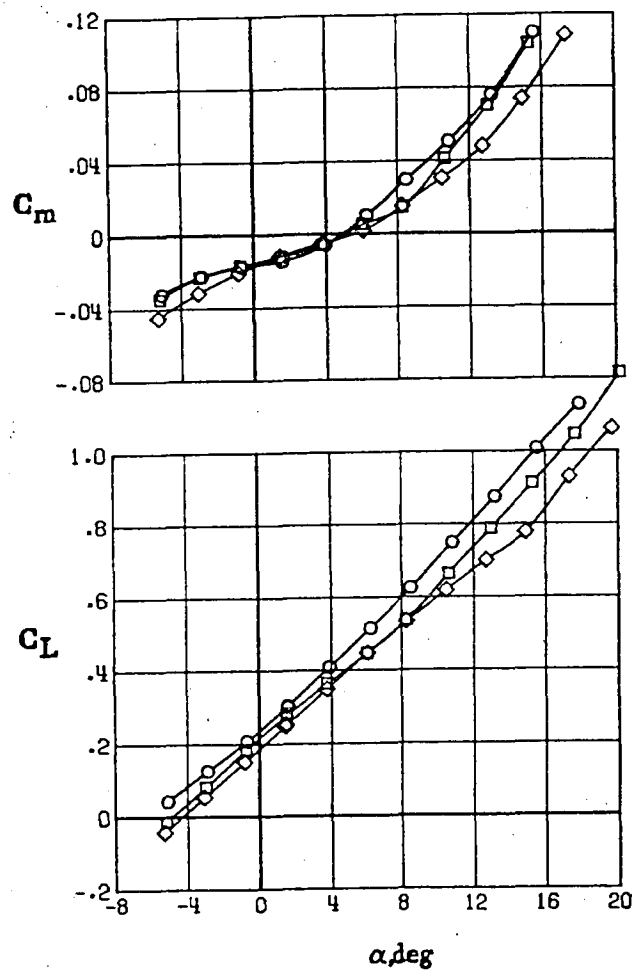
$\delta_{LE}$ , deg

- 0
- 20
- ◇ 40



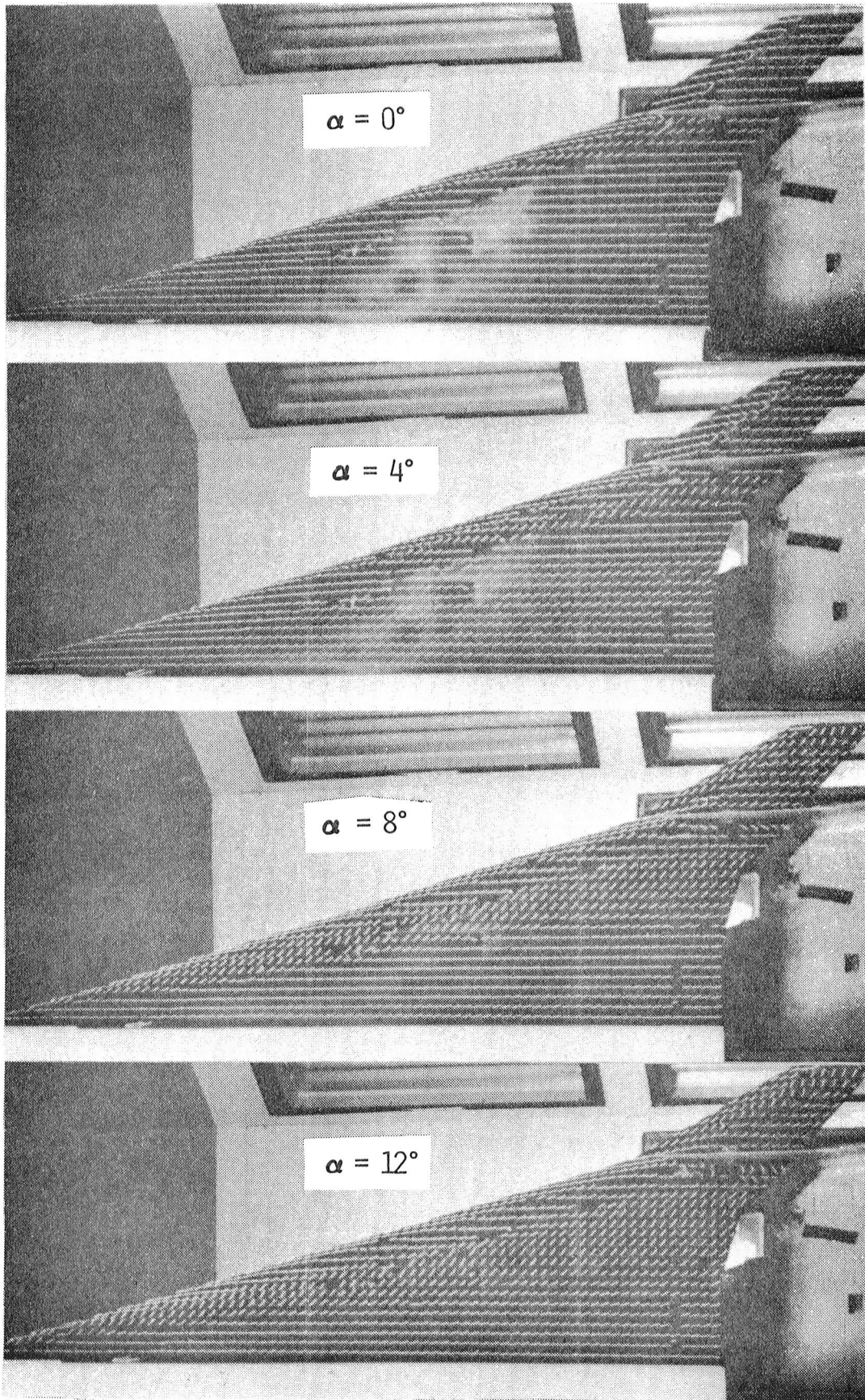
(c) Vertical fins on,  $\delta_f = 20^\circ$ .

Figure 12. - Continued



(d) Vertical fins off,  $\delta_f = 20^\circ$ .

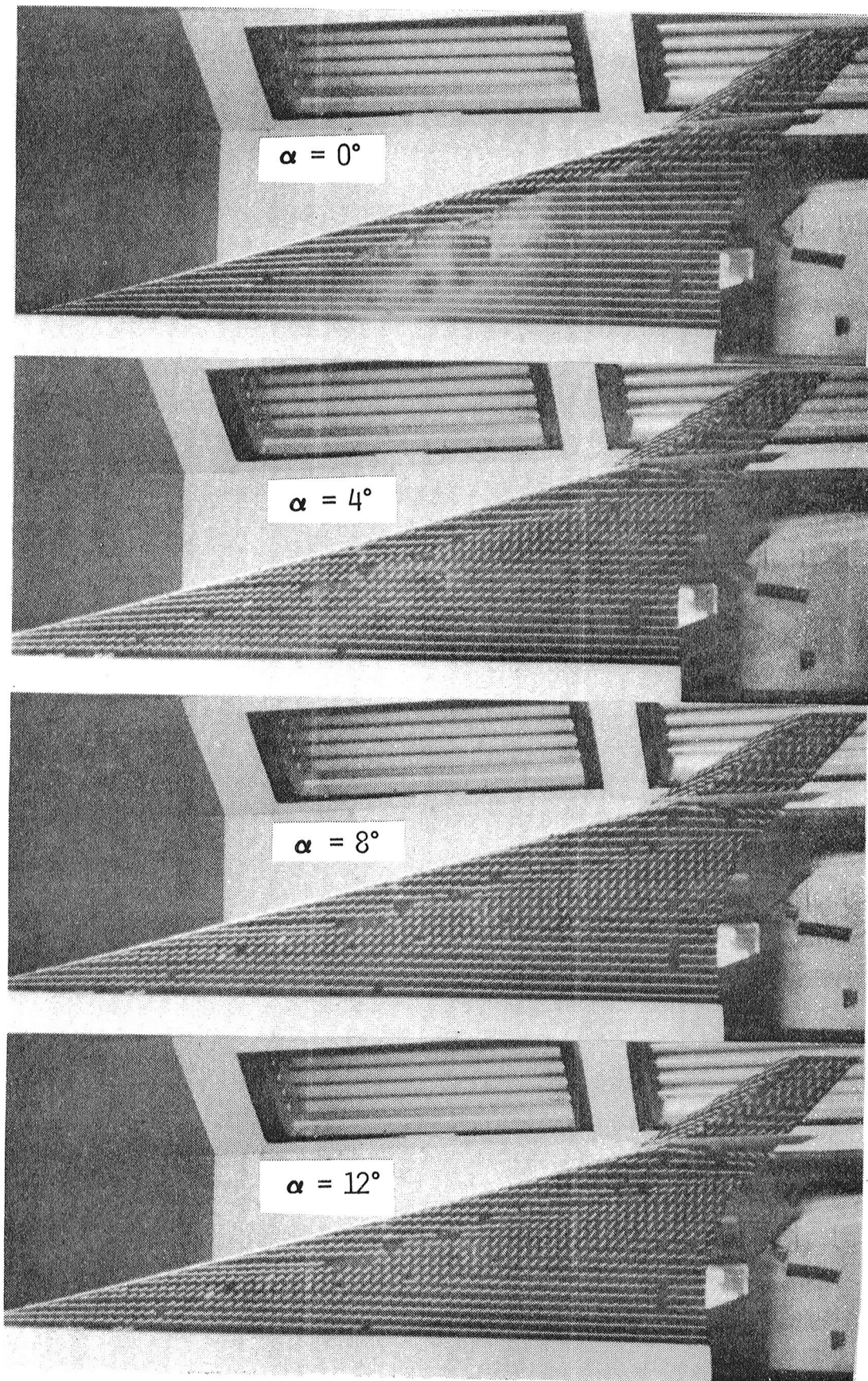
Figure 12. - Concluded



(a)  $\delta_{LE} = 20^\circ$ .

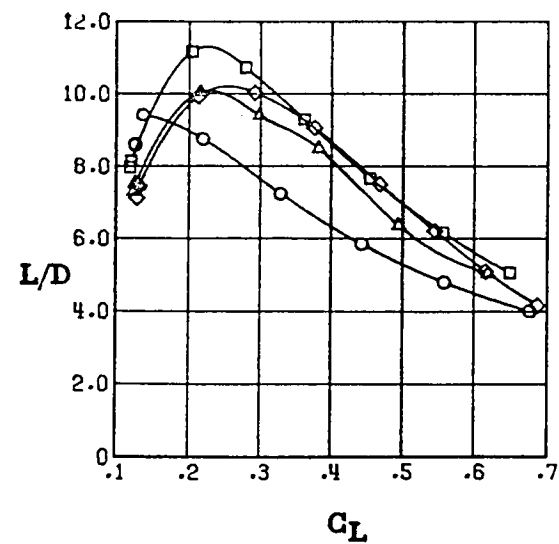
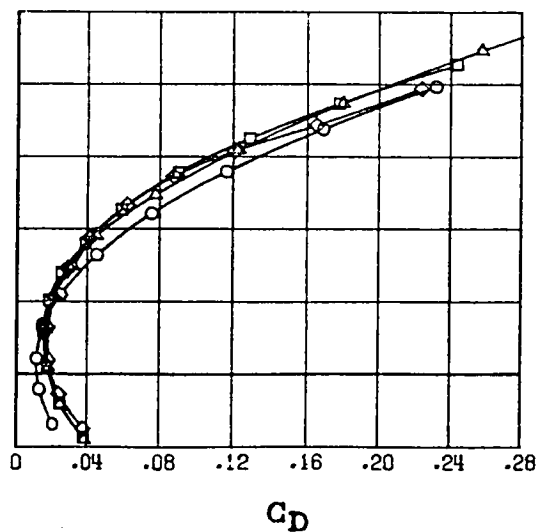
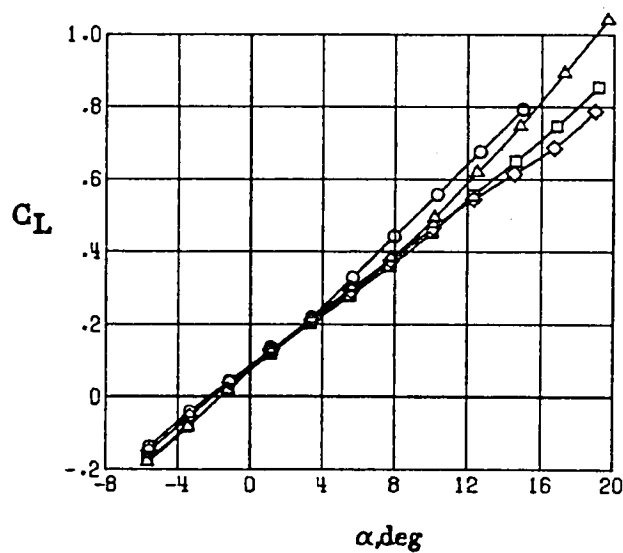
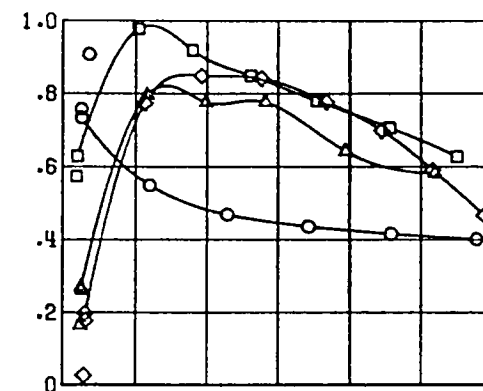
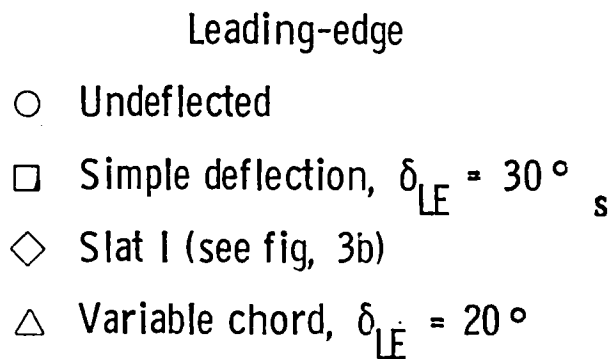
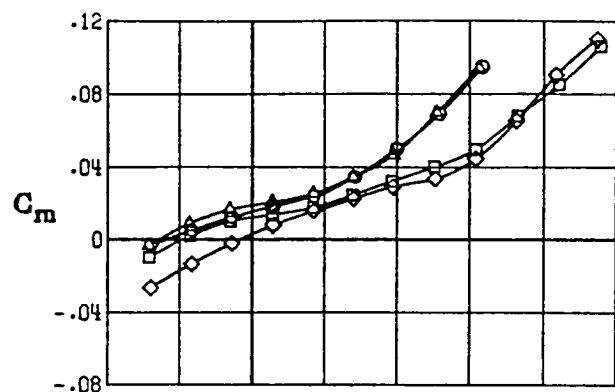
Figure 13. - Tuft Photographs of the Configuration With Variable Chord Leading Edge.





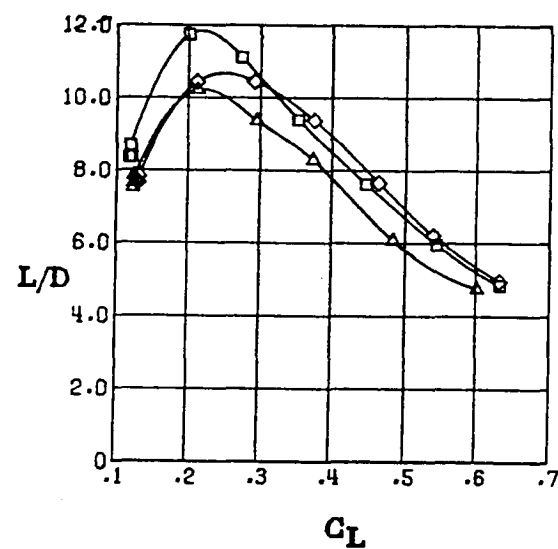
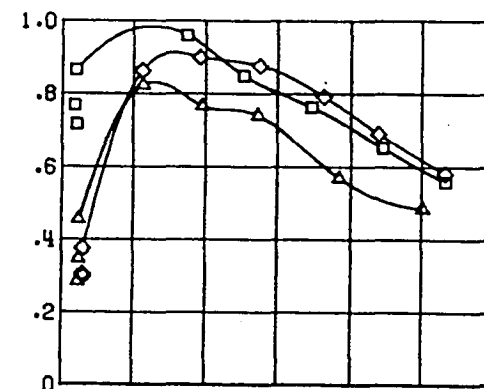
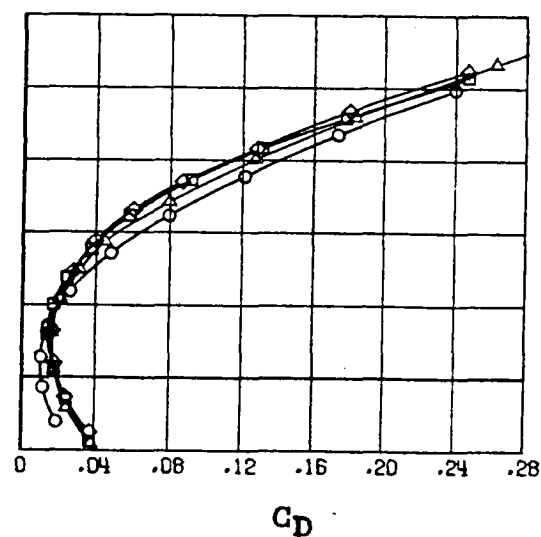
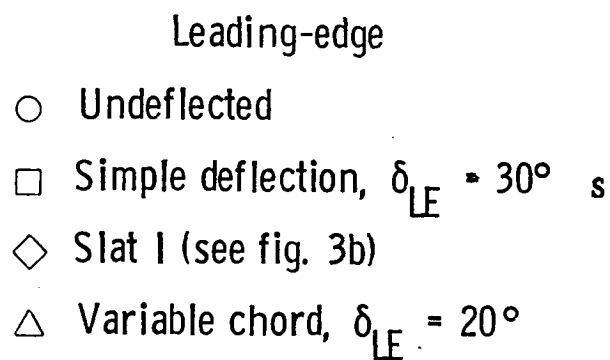
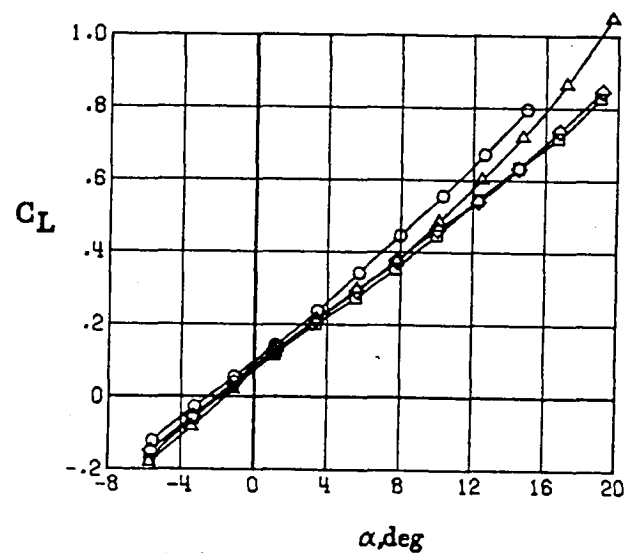
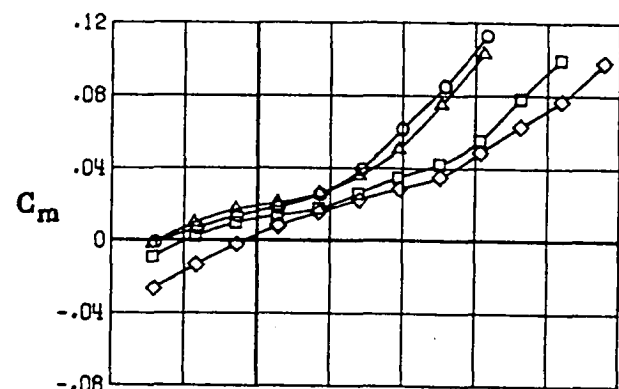
(b)  $\delta_{LE} = 40^\circ$ .

Figure 13. - Concluded.



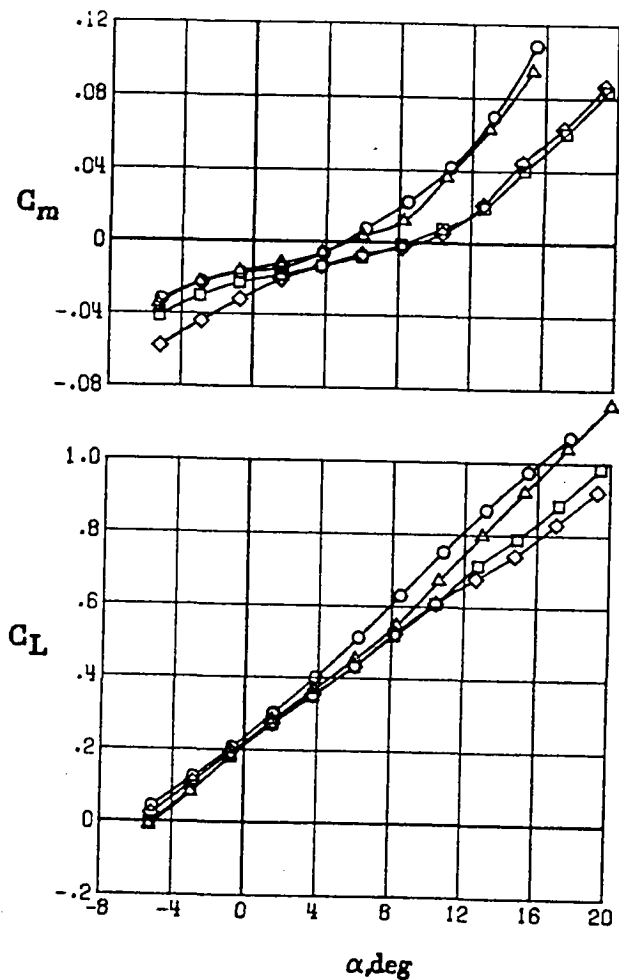
(a) Vertical fins on,  $\delta_f = 0^\circ$ .

Figure 14. - Comparison Of Longitudinal Aerodynamic Characteristics Of Configuration With Various Leading-Edge Devices.

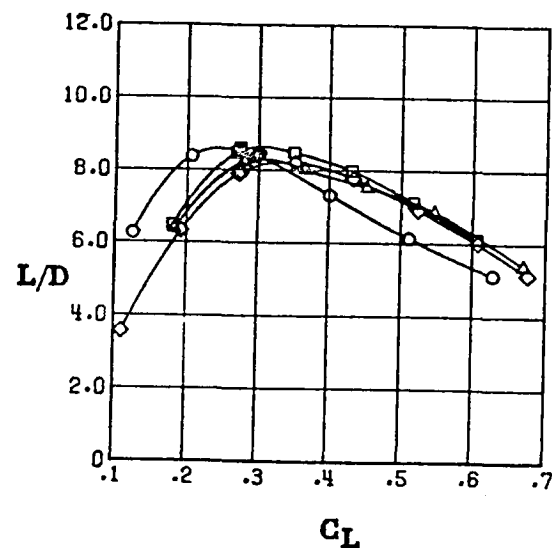
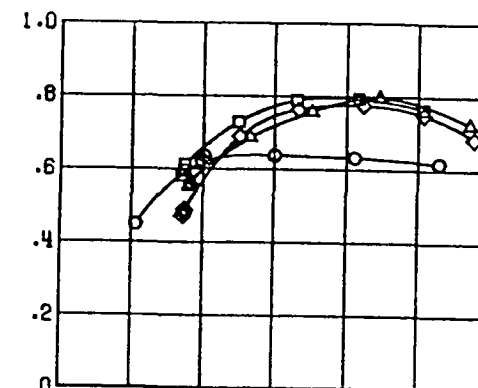
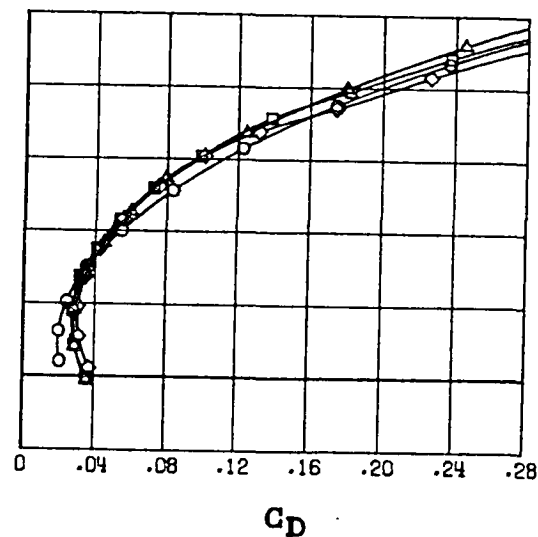


(b) Vertical fins off,  $\delta_f = 0^\circ$

Figure 14. - Continued

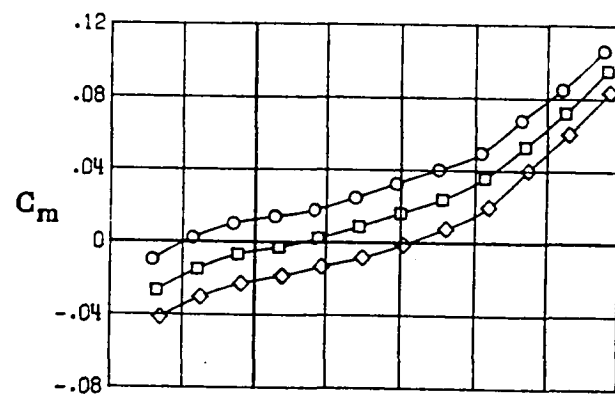


- Leading-edge
- Undeflected
  - Simple deflection,  $\delta_{LE} = 30^\circ$
  - ◇ Slat I (see fig. 3b)
  - △ Variable chord,  $\delta_{LE} = 20^\circ$



(c) Vertical fins on,  $\delta_f = 20^\circ$ .

Figure 14. - Concluded

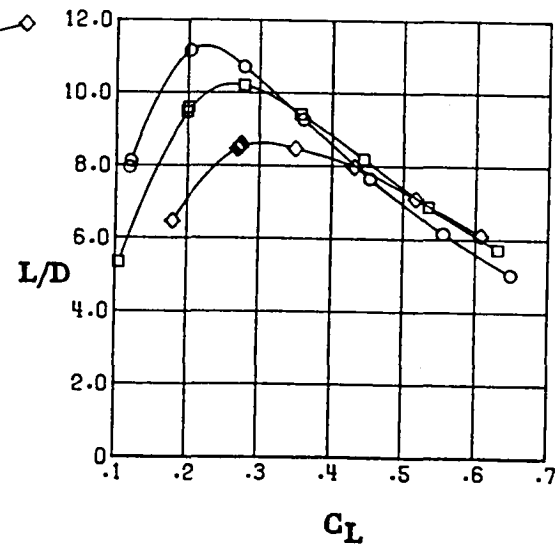
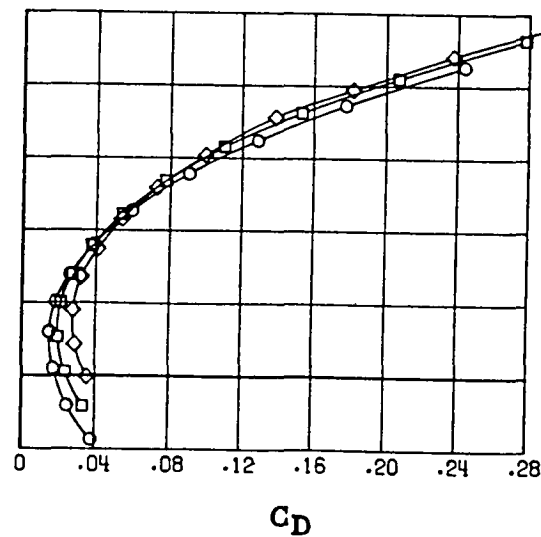
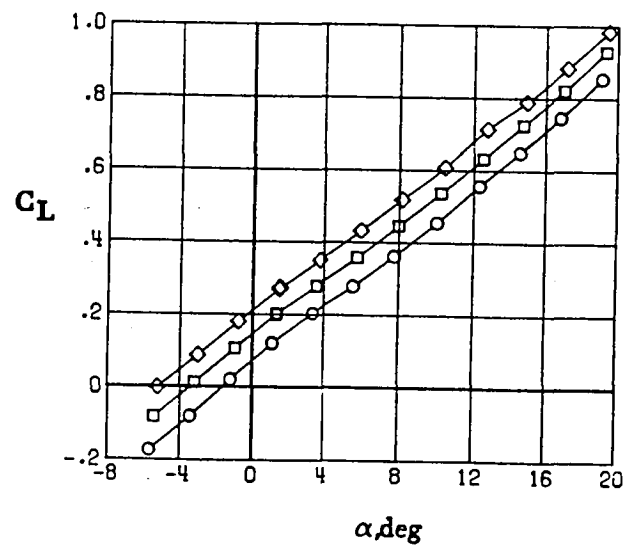
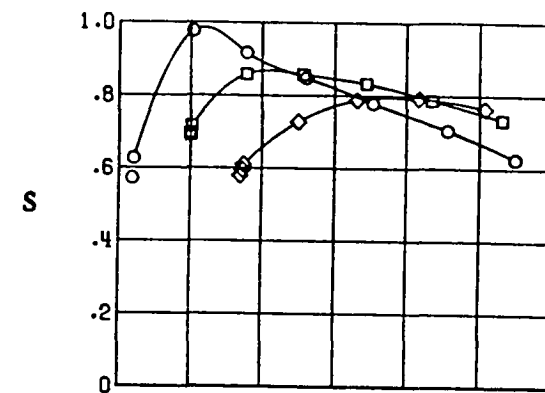


$\delta_f$ , deg

○ 0

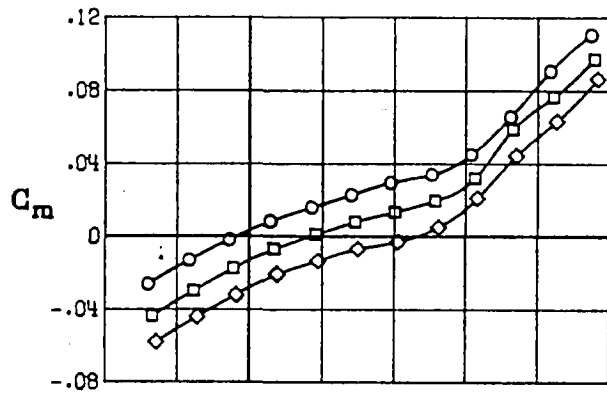
□ 10

◇ 20



(a) Simple leading edge,  $\delta_{L.E.} = 30^\circ$

Figure 15.- Effect Of Trailing Edge Flap Deflection On Longitudinal Aerodynamic Characteristics

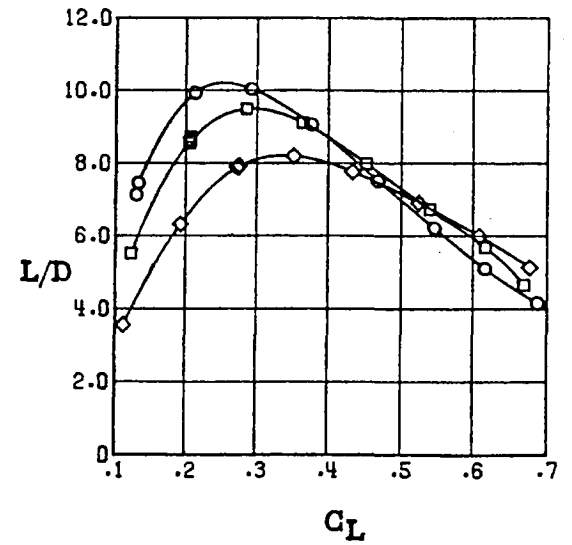
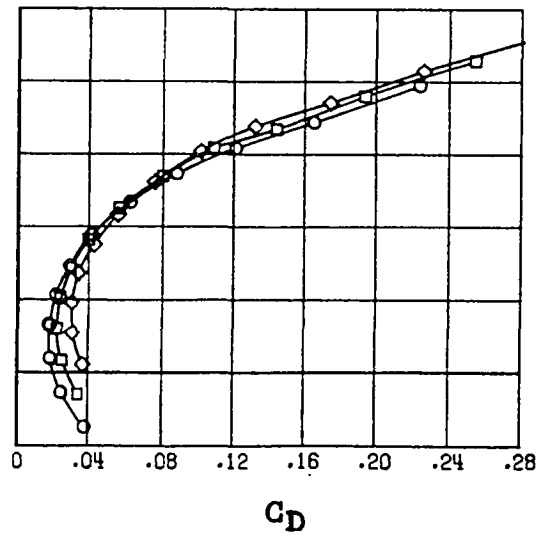
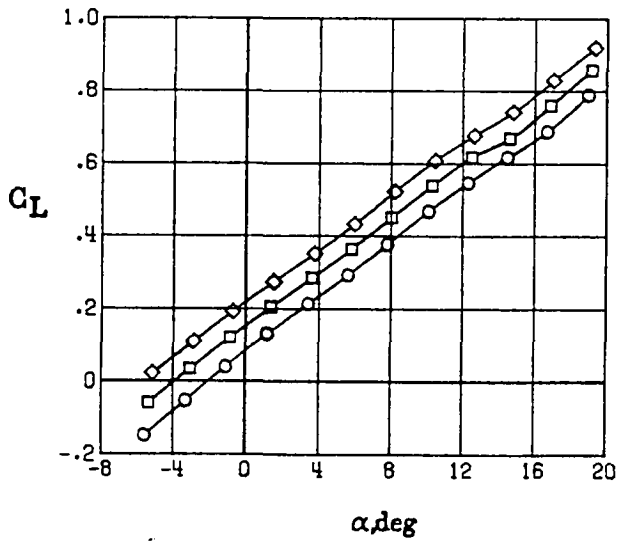
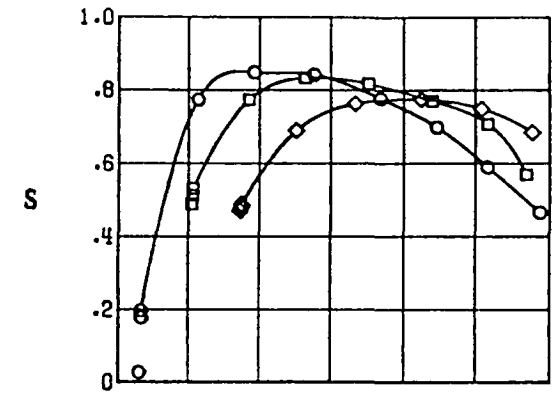


$\delta_f$ , deg

○ 0

□ 10

◇ 20



(b) Slat I.

Figure 15. - Concluded

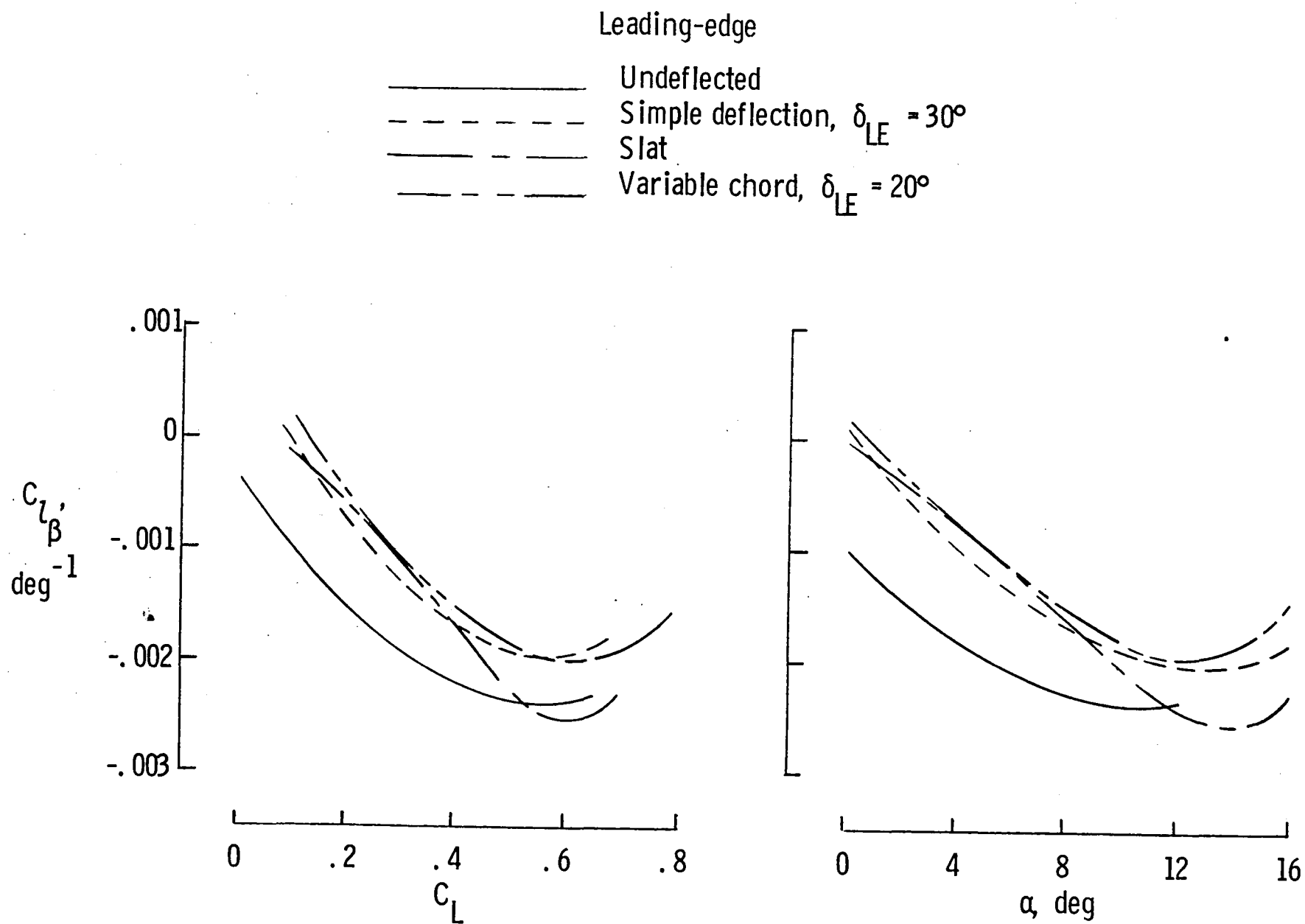


Figure 16. - Influence Of Leading-Edge Configuration On Effective Dihedral.

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| 16. Abstract<br><p>An investigation was conducted in the Texas A&amp;M University 7-by 10-foot Low-Speed Wind Tunnel to provide a direct comparison of the effect of several leading-edge devices on the aerodynamic performance of a highly-swept wing configuration. The tests were conducted over an angle-of-attack range of <math>-6^\circ</math> to <math>16^\circ</math>, for a Mach number of 0.21 and a Reynolds number (based on the mean aerodynamic chord) of <math>4.1 \times 10^6</math>.</p> <p>Analysis of the data indicates that for the configuration with undeflected leading edges, vortex separation first occurs on the outboard wing panel for angles of attack of approximately <math>2^\circ</math>, and wing apex vortices become apparent for <math>\alpha &gt; 4^\circ</math>. However, the occurrence of the leading-edge vortex flow may be postponed with leading-edge devices. Of the devices considered, the most promising were a simple leading-edge deflection of <math>30^\circ</math>, and a leading-edge slat system. The trailing-edge flap effectiveness was found to be essentially the same for the configuration employing either of these more promising leading-edge devices.</p> <p>Analysis of the lateral-directional data showed that for all of the concepts considered, deflecting leading edge downward in an attempt to postpone leading-edge vortex flows, has the favorable effect of reducing the effective dihedral.</p> |  |  |   |  |  |
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